170. What is the purpose of ta cross-cut fissure design bur?

A. cut smoother margins
B. cutting efficiency
C. microretention of preparation
D. plane the tooth surface

ANSWER: B. cutting efficiency

Cross-Cut Fissure are primarily effective for cutting dentin at slow speeds, although in their carbide form at a high speed they effectively reduce enamel and dentin. To prevent fracture the blades are more blunt and the cross grooves less deep than with a steel bur. Steel blades are more fragile and thin than carbide blades, yet their thin cutting edges enable them to shave away dentin better than their carbide counterpart.

Baum, Lloyd. Textbook of Operative Dentistry, 3rd Edition, 1995

Cross-cut or dentate burs are employed for removal of old restorations, but the horizontal ridges they leave on tooth structure make them unacceptable for planning tooth surfaces.

Shillingburg, H. Fundamentals of Fixed Prosthodontics, 3rd Ed. 1997

171. Which of the following amalgam alloy configurations require less mercury due to their particle size/shape?

A. Lathe-cut
B. Spherical
C. Admixed
D. There is no difference between particle geometry and size

Answer: B. Spherical

It was demonstrated that by spherodizing the alloy particles, the particles packed more efficiently and required much less mercury to make a practical mixture. Spherical particles also increased the fluidity of the mixture by presenting less resistance to particle sliding. Using some or all spherical particles, it is possible to reduce the mercury portion of the mixture to less than 50% by weight.

High copper content amalgam has at least 12% copper in it. This helps cut down on corrosion, by eliminating the gamma 2 phase (Hg-Sn).
Classification of dental amalgams based on copper contents is the main system in use today.

Sturdevant, Roberson, Heymann. The Art and Science of Operative Dentistry, 3rd edition, 1995.

172. A major advantage for the use of glass ionomer restoration is fluoride release. Fluoride release

a. Does not require water movement
b. is released in the form of SnF
c. can be released again in 8 hours if recharged
d. is not part of the structural matrix of the material
e. is derived from high temperatures used during glass fusion

ANSWER D. is not part of the structural matrix of the material

Fluoride Release

a. derived from flux used during glass fusion
b. fluoride release is not part of the structural matrix of the material
c. fluoride released in form of NAF
d. initial high fluoride release (1-2day burst) followed by low sustained release, constant release occurs at about 3 weeks
e. fluoride release requires water movement
f. more fluoride is released from type II glass ionomers than from liners or luting cements
g. applying varnish or resin to the surface of the restoration decreases fluoride release until abrasion removes the coating
h. restorations with larger surface area release more fluoride
i. materials must be recharged in order to provide fluoride levels necessary to remineralize tooth structure
j. most recharged fluoride released again in 24 hours
k. application of acidic fluorides should be avoided with glass ionomer restorations as the acid will cause surface deterioration of the restoration
l. higher fluoride releasing materials are more effective at reducing recurrent caries than are low fluoride releasing materials.

Glass Ionomer Cements, August 2006 CAPT N.B. Cook/CDR J.S. Nordin

173. Compomer dental restorative materials:

A. have physical and mechanical properties similar to resin composites
B. have lower composite content than resin-modified glass ionomers
C. release more fluoride than conventional glass ionomers
D. do not require a bonding system

Answer: A. have physical and mechanical properties similar to resin composites

Glass Ionomer	***RMGI***	***Compomer***	***Resin Composite***
Contains water	Contains water	No water	No water
Powder-Liquid only	Powder-liquid or Paste-paste	VLC paste	VLC paste or Paste-paste
Acid-base only	Acid-base and radical	Radical only	Radical only

Reference: *Summit, Robbins, Hilton, Schwartz, Santos, Jr., "Fundamentals of Operative Dentistry; A Contemporary Approch", third edition, 2006.*

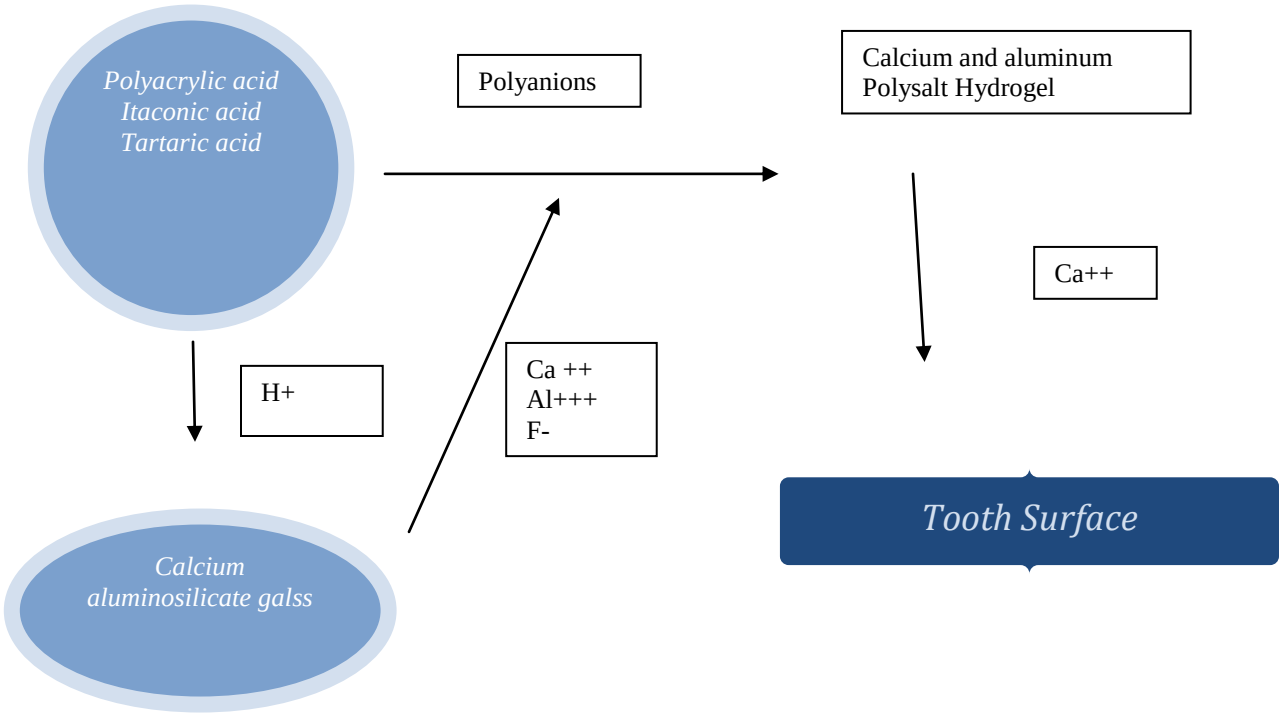
174. Which restorative material's setting reaction is largely light polymerization with some acid base reaction occurring with water contact?

a. RMGI
b. GI
c. Composite (self –cure)
d. Compomer

ANSWER D. Compomer

Setting reaction of Glass Ionomer

The setting reaction is an acid-base reaction between the acidic polyelectrolyte and the aluminosilicate glass.



The polyacid attacks the glass to release cations and fluoride ions. These ions react with the polyanions to form a salt gel matrix. During the initial setting reaction in the first 3 hours, Ca++ ions react with the polyacrylate chains. Then the Al+++ ions react for at least 48 hours. The structure of the fully set cement is a composite of glass particles surrounded by silica gel in a matrix of polyanions crosslinked by ionic bridges. Within the matrix are small particles of silica gel containing fluoride cyrstallites. Glass ionomer cements bond chemically to the enamel and dentin during the setting process. **The mechanism appears to involve an ionic interaction with calcium and phosphate ions from the surface of the enamel or dentin.**

Setting reaction of Resin Modified Glass Ionomer

The setting reaction of resin modified glass ionomer cement compromises 2 different mechanisms. The first is an acid base reaction just like with Glass Ionomers. The second is either a light cured or self cured polymerization reaction of the methacrylate groups. **Therefore two types of bonding to tooth structure that occur, an ionic and a hybrid layer bond.**

Setting reaction of Compomers

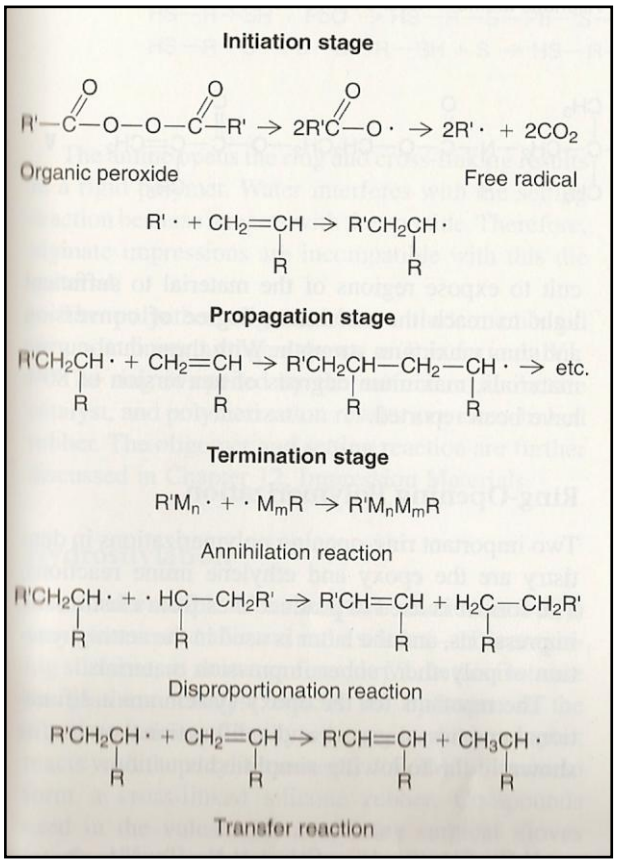
Compomers or poly-acid modified composites are used for restorations in low stress bearing areas. Compomers contain poly acid modified monomers with fluoride releasing silicate glasses and are formulated without water. The volume percent filler ranges from 42%-67% and the average particle size ranges from 0.8 – 5.0um. **Setting occurs primarily by light cured polymerization, but an acid-base reaction also occurs as the compomer absorbs water after placement and upon contact with saliva**. Less release of fluoride than by GI or RMGI and do not recharge as well.

Setting Reaction of Composites

Composite resin setting reaction is an addition polymerization reaction in which no by product is obtained. It is a free-radical polymerization reaction which takes place in 3 stages: initiation, propagation, and termination. The reaction may be accelerated by heat, light, traces of peroxides, and other chemicals.

Initiation stage: free radicals are produced by either 1) benzoyl peroxide + aromatic tertiary amine or 2) camphoroquinone + aliphatic amine + visible light (460nm)

Propagation stage: rapid addition of monomer molecules to the free radical and the shifting of the free electron to the end of the growing chain
Termination stage: the growing free radical is terminated by any material that will react with a free radical, thus decreasing the rate of initiation or increasing the rate of termination. Hydroquinone, eugenol, or large amounts of oxygen will inhibit or retard polymerization.



175. Resin modified glass-ionomer(RMGI) cements was formulated to overcome the practical limitations of conventional glass ionomer cements. Clinically RMGI cements

a. Can be used as a retrograde root-filling material
b. Are light cured only, no chemical cure component
c. Is not rechargeable because of the addition of methyacrylate resin
d. Require cavosurface bevels of the preparation for restorations

ANSWER: A. Can be used as a retrograde root-filling material

To overcome the practical liminations of conventional glass ionomer cements, yet preserve their clinical advantages, convetional glass-ionmer chemistry was combined with methacrylate resin technology; this led to the creation of resin-modified glass-ionmer systems. **They are often incorrectly referred to as light-cured glass-ionomer cements. The term dual-cured is more appropriate, because the original acid-base reaction is supplemented by light-activated polymerization.**
Generally these materials still have ion-leachable fluoroaluminosilicate glass in the powder, but they also contain monomers, primarly HEMA, and photoinitiator, camphoquinone, whac are added to the adquious polyacid liguid. In the simplest form of RMGI cement some of the water content of the convetional glass-ionomer cement is replaced by a water-HEMA mixture, whil The first setting reaction is a slow acid-base reaction, typical of

conventional glass-ionomer cments. The photoinitiated setting reaction occurs much faster. A true RMGI is defined as a two-part system characterized by an acid-based reaction critical to its cure, diffusion-based adhesion between the tooth surface and the cement , and continuing fluoride release. The underlying mechanism of adhesion of glass-ionomer cements to tooth structure is primarily based on an ion-exchange process, resulting in a shallow demineralization and subsequent infiltration of the tooth surface by the polyalkenoic acid, and in a strong ionic bone between the calcium of the hydroyzpatite and the carboxyl groups of the polyalkenoic molecules. **Clinically, glass-ionomer cement can be used as a luting agent, as a cavity liner or base, as a core buildup material, as a direct restorative material in permanent and primary teeth, as a pit and fissure sealant, as a provisional restorative material, and as a retrograde root-filling material.**

Resin modified glass ionomers are easier to use than conventional glass-ionmer cments. The supplementary light polymerization allows a longer working time, a rapid hardening on command, and a more rapid early development of strength and resistance against aqueous attach than are found with conventional glass-ionomer cements. **The fluoride release of RMGI cements is reported to be equal to or greater than that of conventional glass-ionomer cements, and the fluoride-releasing property may even be rechargeable.**

Because of their anti-caries effect**, resin-modified glass-ionomer restorative materials may be used in Class 3 restorations in patients at high risk for caries. Preparations for these materials should resemble those for resin composite; no bevels are necessary**. The only reason that noncarious tooth structure should be removed is to allow access for excavation of the carious dentin. Because these materials bond to enamel and dentin, the placement of retention grooves or points is not necessary.

Glass ionomer has been used successfully in Class 5 restorations for many years. One clinical study reported an 80% retention rate of restorations placed without mechanical retention at 10 years. Traditional glass-ionomer materials suffer surface degradation rather rapidly, especially in the presence of acidic foods. Resin-modified glass ionomers (RGMIs) appear to offer high fluoride release and excellent recharge capacity. Patients at high risk for caries would probably be best served with RMGI restorations on root surfaces.

The preparation for glass-ionomer restorations is similar to that for resin composite. **Cavosurface bevels are not recommened for the preparation because glass ionomer is a brittle material that requires bulk**. After placement of RMGI material into the preparation, it is light polymerized in a manner similar to photocuring resin composite. The use of a clear cervical matrix is optional. The restoration may be controured and poslished immediately with the same techniques described for resin composite. Retention rates of 93% and 99% after 2 years have been reported for Class 5 RMGI restorations placed in npreparations without mechanical undercuts.

176. Which of the following is true regarding At-home vs. In-office whitening?

A. 20% Hydrogen Peroxide whitens twice as fast as 10%Hydrogen Peroxide
B. In office bleaching typically consists of 35-50% Hydrogen Peroxide
C. At Home bleaching typically consists of 10-35% Hydrogen Peroxide
D. In office bleaching used alone has better results than at home bleaching

ANSWER: B. In office bleaching typically consists of 35-50% Hydrogen Peroxide

"The higher the concentration of peroxide, the more rapid the lightening effect, although the effect is not linear (ie, 20% is not twice as fast as 10%). In-office bleaching materials are usually supplied in concentrations of 35% Hydrogen Peroxide, although some concentrations may be as high as 50%.

… The usual concentration of the At-Home bleaching agents is 10% Carbamide Peroxide (equal to approximately 3.4% Hydrogen Peroxide), which is relatively safe in contact with soft tissue.

… There are several potential disadvantages (with In-office bleaching), however… there is a possibility of tissue injury from the more potent agent used; and the results may not be as good as with the slower at-home method."

Summit JB. Fundamentals of Operative Dentistry, 3rd Ed. 2006; 15; 439-43.

177. Which of the following statements is incorrect regarding bleaching tetracycline stained teeth?

a. Tetracycline stained teeth may take as long as 2-6 months or longer of nightly bleaching treatment to achieve a satisfactory result.
b. Bleaching of gray coloration is more difficult (compared to other type of discoloration), especially when located at the cervical of the tooth.
c. Uniform discolorations are more difficult than banded discolorations, especially if the center band is gray.
d. Not only does tetracycline stain developing teeth, it has been shown to stain fully formed adult dentition

Answer: C. Uniform discolorations are more difficult than banded discolorations.

- Generally dark grays only get lighter, but not white.
- Banded discolorations are more difficult than uniform discolorations, especially if the center band is gray.
- Minocycline, a popular acne treatment, is a tetracycline analogue. There are several reports in literature of white teeth subsequently becoming gray during minocycline ingestion.
- Tetracycline is considered as treatment for Rocky Mountain spotted fever and other diseases as cystic fibrosis

VB Haywood, et. al., Bleaching and Esthetic Bonding of Tetracycline-Stained Teeth, Contemporary Esthetics and Restorative Practice, 16-23, Oct 2004.

Roberson, TM et al, Sturdevant's Art and Science of Operative Dentistry, 4th ed. Mosby 2002

178. Which of the following is true regarding the acid-etching of enamel and dentin?

A. Dentin must be etched for a longer period of time compared to enamel
B. Enamel must remain moist to allow resin tags to infiltrate
C. 35-37% Hydrofluoric acid, is still the most widely used etchant today
D. Enamel etching raises the surface energy of the enamel

ANSWER: D. enamel etching raises the surface energy of the enamel

Bond strengths to etched enamel range from 15 to 25 MPa, depending on the resin and testing method used. A bis-GMA/triethylene glycol dimethacrylate (TEGDMA) resin tends to yield lower bond strength values, whereas some of the newer enamel and **dentin bonding agents** can increase bond strength. These differences in bond strength are small, and because of large variations during testing, they are unlikely to be clinically significant. However, these in vitro differences may be associated with the better wetting capability of the etched enamel by the newer materials. Drying of the **enamel** with warm air or using an ethanol rinse can increase the bond strength, suggesting that moisture may still be trapped in the micropores even when the surface appears dry. In summary, the acid-etch technique has resulted in a simple, conservative, and effective use of resin in many dental procedures.

The etch pits result from selective dissolution of either the enamel rod cores (Type I etching), or the peripheral areas (Type II etching). In either case, the resin tags are approximately 6 µm in equivalent diameter and 10 to 20 µm in length. (In aged extracted teeth, the tags may be 100 to 200 µm in length.)

Etch dentin and enamel simultaneously with conditioner (usually phosphoric acid). Most dentin bonding systems are provided with a conditioner, often an acid that can remove the smear layer and expose a collagen network. The dentin is conditioned most commonly for 15 sec and the conditioner and precipitate are subsequently rinsed away. Excess water is then removed from the etched and rinsed dentin surface, without desiccating the collagen mesh. If the mesh is desiccated, the collagen network will collapse and form a dense film that is difficult to infiltrate with the primer.

… **phosphoric acid**, is still the most widely used etchant today for binding to enamel and dentin.

The etch pits result from selective dissolution of either the enamel rod cores (Type I etching) as shown in, or the peripheral areas (Type II etching) as indicated by the resin tags in. Although **enamel** etching raises the surface energy of the enamel, contamination can readily reduce the energy level of the etched surface.

Anusavice, Kenneth J. Phillips' Science of Dental Materials, 11th Ed. W.B. Saunders Company, 2003. 17.4.
179. The differences in depth of penetration between total etch and self etching adhesives depends on the strength of the acid. It has been found the average difference of penetration is:

a. 5 -6 μm with total etch being shallower
b. 6-10 μm with self etch adhesives being shallower
c. 10- 15 μm with total etch being deeper
d. 1-4 μm with self etch adhesives being shallower

ANSWER d. 1-4 *u*m

Abstract
Objective: This study examined, with the use of transmission electron microscopy (TEM), the aggressiveness of three self-etching adhesive systems in penetrating dentin smear layers of different thickness.
Significance: Contemporary self-etching systems may be classified as mild, moderate and aggressive based on their ability to penetrate dentin smear layers and their depth of demineralization into the subsurface dentin. The more aggressive system completely solubilized the smear layer and smear plugs and formed hybrid layers with a thickness approaching those of phosphoric acid conditioned dentin.

Pashley, D.H. Dental materials, Vol 17 issue 4 July 2001, pgs 296-308

The interface obtained with SBMP (Total etch) on unground phosphoric acid-etched enamel can be observed. Macroretentive resin tags, and microretentive resin tags are clearly visible, **as well as a 5- to 8- µm-thick layer of adhesive.**
SEM images showing bovine ground enamel surfaces conditioned **with LP (self etch)** for 15 s. Mineral dissolution among the prisms and between the crystals is clearly evident, although the **depth of demineralization is 1/3 to 1/4 of that seen with the conventional adhesive system**

Gabriela IbarraClin, Oral Invest (2006) 10:331–341

180. Which of the following statements is incorrect regarding enamel etching and adhesion:
A. Self-etching adhesives perform better on prepared enamel
B. Self-etching adhesives perform better on unprepared aprismatic enamel
C. A deep inter-prismatic etching pattern is accomplished with total-etch systems
D. Self-etching systems result in an etching pattern ranging from absent to moderate.

Answer: B. Self-etching adhesives performed better on unprepared aprismatic enamel

- Self-etching adhesives performed better on prepared enamel than on unprepared (Aprismatic) enamel
- The field-emission SEM revealed a deep inter-prismatic etching pattern for the total-etch adhesive, whereas the self-etching systems resulted in an etching pattern ranging from absent to moderate.

Bonding Characteristics of Self-etching Adhesives to Intact versus Prepared Enamel, J. Perdigao, S. Geraldeli. Journal of Esthetic and Restorative Dentistry, Vol 15, Issue 1, pages 32–42, January 2003

181. External root resorption in non-vital bleaching occurs in 1-7% of teeth. Research has shown that placement of an intra-orifice barrier
a. Prevents external resorption when placed at the cervical portion of the tooth
b. Is not recommended due to its questionable safety and lack of effectiveness
c. Increases the diffusion of high concentrations of chemicals
d. Should not allow the bleaching agent to extend to the level of the PDL

ANSWER: D. Should not allow the bleaching agent to extend to the level of the PDL

A more serious problem that affects about 7% of the teeth that have undergone internal bleaching is the occurrence of external root resorption, which often causes tooth loss. While the causes of root resorption are not fully known, a review of the literature indicates a number of possible causes. **The patients in which root resorption occurred tended to be younger than 25 years old, and most had traumatic injury.** Some underwent bleaching with the application of heat and some did not, but **heat does appear to be a causative factor**. Any one of **several factors** may also need to be present for resorption to occur, including: 1-dificieny in the cementum, exposing the cervical dentin to the oral cavity; 2-injury to the periodontal ligament, triggering an inflammatory response (trauma); 3-infection, sustaining the inflammation; 4-lack of a seal over the gutta-percha; 5-high heat; and 6-high concentration of hydrogen peroxide.
Research has been conducted to determine if a protective restorative material can be placed in the cervical portion of the tooth to prevent external resorption. **Unfortunately, this barrier layer reduces the diffusion but <u>does not prevent it</u> and does not necessarily protect the tooth against root resorption.** However, most of the teeth reported with cervical resorption did not have a barrier placed over the gutta percha. It is not prudent to use heat or high concentrations of peroxide and a barrier layer should be placed over the gutta percha.
For the best combination of safety and effectiveness, the recommended treatment for internal bleaching is sodium perborate mixed with water or 10% carbamide peroxide, used after the placement of a protective barrier material in the cervical area.

Natural Tooth Bleaching. Fundamentals of Operative Dentistry, 3rd edition, Summit et al

There is a **slight potential that cervical resorption will occur in non-vital bleaching (i.e. 1%)** However, this sequela has been **observed most when thermocatalytic** technique is employed. Although sodium perborate may bleach more slowly when used alone, it is known to be safer. **However, intra-orifice barrier is still recommended not only to prevent cervical resorption but also to reduce contamination of gutta percha.** To reduce the possibility of resorption even more, **placing calcium hydroxide in the pulp chamber after bleaching for two weeks has been recommended.**

Roberson, TM et al, Sturdevant's Art and Science of Operative Dentistry, 4th ed. Mosby 2002.

Although nonvital bleaching is effective, there is a **slight potential (i.e.1%) for a deleterious side effect termed external cervical resorption**. This sequel requires prompt and aggressive treatment. In animal models, cervical resorption has been **observed most when using a thermocatalytic technique with high heat.** The "walking bleach" technique or an in-office technique that does not require the use of heat is preferred for nonvital bleaching. **To reduce the possibility of resorption, immediately after bleaching, a paste of calcium hydroxide powder and sterile water is placed in the pulp chamber. Also, sodium perborate alone,** rather than in conjunction with hydrogen peroxide, should be used as the primary bleaching agent. Although sodium perborate may bleach more slowly, it is safer and less offensive to the tooth. **A more contemporary technique uses 30 to 35% hydrogen peroxide pastes or gels that require no heat.** In both techniques, it **is imperative that a sealing cement (resin-modified glass-ionomer cement is recommended) be placed over the exposed root canal filling before application of the bleaching agent to prevent leakage and penetration of the bleaching material in an apical direction.** It also is recommended that the bleaching agent be applied in the coronal portion of the tooth incisal to the level of the periodontal ligament **<u>(not down into the root canal space) to prevent unwanted leakage of the bleaching agent through lateral canals or canaliculi to the periodontal ligament</u>** Periodic radiographs should be obtained after bleaching to screen for cervical resorption, which generally has onset in 1 -7 years.

Sturdervant's Art and Science of Operative Dentistry, 5th edition, Mosby 2006

182. What is the design for performing a mini-flap when restoring root surface caries?
A. Incisions at the mesial and distal line angles straight apically
B. Vertical incisions that bisect the papilla on each side
C. Incisions at the line angles, initially toward the papilla and then apically
D. Envelope flap incorporating at least 1 tooth on either side

ANSWER: C. Incisions at the line angles, initially toward the papilla and then apically

"For this technique (sometimes referred to as a miniflap procedure) to be successful, the periodontium must be healthy. The incisions should be confined to the keratinized gingival tissue and kept as short as possible (just long enough to allow adequate exposure for isolation). Incisions can often be limited to the free gingiva, and, although reattachment to previously unexposed cementum can be expected, unnecessary severing of attachment should be avoided. Full thickness vertical incisions should be initiated at the mesial and/or distal aspects of the facial and should be directed perpendicular to the root and surface of bone, first slightly toward the interproximal papilla, then apically."

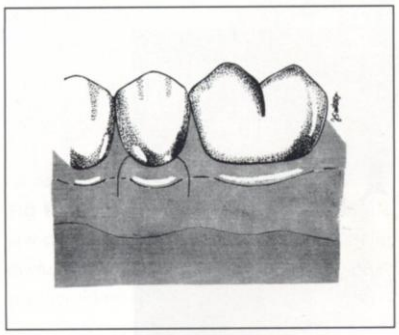
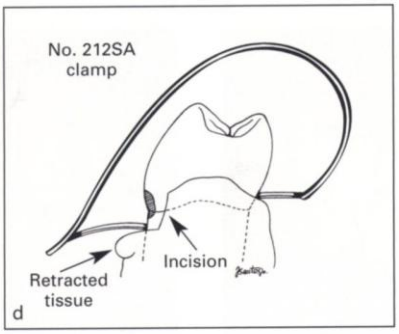
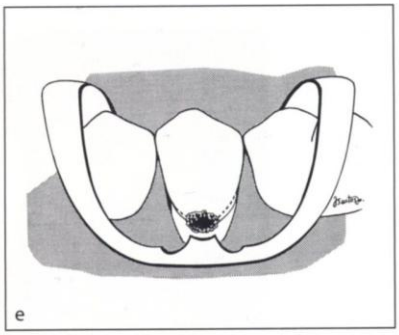


Fig 14-9c Short vertical incisions are made within the keratinized tissue at the line angles of the tooth. This allows additional tissue retraction with minimal trauma to the tissue or attachment apparatus.





Figs 14-9d and 14-9e The No. 212SA retracting clamp and rubber dam are in place. This clamp should always be stabilized with modeling compound or similar material.

Summitt J. Fundamentals of operative dentistry: A contemporary approach, 3rd Edition Quintessence Publishing, 2006. 7, 175-6.

183. Which of the following is incorrect regarding veneering the tetracycline stained tooth?

A. A more esthetic result can be achieved by leaving a thin layer of enamel
B. Ensure proximal extensions are into contact area
C. Ensure all discolored enamel is removed to expose dentin
D. Extend gingival margin into sulcus (do not encroach on biologic width)

Answer: C. Ensure all discolored enamel is removed to expose whiter dentin

Tetracycline stain tends to get darker as more enamel layer is removed since the tetracycline stain is mainly incorporated into dentin.
More esthetic result can be achieved by leaving thin layer of enamel over the stained area than attempting to remove the stain.
Tetracycline teeth are more difficult to veneer if the dark banding occurs in the gingival third
Extend gingival margin into sulcus (do not encroach on biologic width)
Increased labial reduction - allow for more porcelain thickness to cover discoloration
Ensure proximal extensions are into contact area

VB Haywood, et. al., Bleaching and Esthetic Bonding of Tetracycline-Stained Teeth, Contemporary Esthetics and Restorative Practice, 16-23, Oct 2004.

Roberson, TM et al, Sturdevant's Art and Science of Operative Dentistry, 4th ed. Mosby 2002.

184. Which of the following is incorrect regarding diastema closure preparation for veneers.

A. Diastemata should not be closed without first addressing the underlying cause
B. Rubber dam isolation is recommended
C. Proximal finish lines adjacent to the space must be made more lingual
D. The gingival margin of the veneer should be no more than 2.5mm to the crest of bone

Answer: B. Rubber dam isolation is recommended

- Rubber dam should not be used.
- Diastemata should not be closed without first addressing the underlying cause
- Proximal finish lines adjacent to the space must be made more lingual
- The wider the space to be closed, the more lingually the tooth must be prepared
- Proximal margins adjacent to space must be positioned subgingivally so that the gingival contours of the veneers minimize the black triangle between the bottom of the interproximal contact area and the tip of the papilla
- The gingival margin of the veneer should be no more than 2.5mm to the crest of bone

Summitt, et al. Fundamentals of Operative Dentistry, 3rd edition, 2006.

185. It has been shown that heat or light activation in tooth whitening systems:

a. Can increase the pulpal temperature but is not significant
b. Work well with significant increase in tooth whitening efficacy
c. Have questionable results with possible dangerous increases in intrapulpal temperature
d. Is safe and decreases the time required to achieve a set result

ANSWER: c. Have questionable results with possible dangerous increases in intrapulpal temp
External bleaching procedures utilizing highly concentrated 30–35% hydrogen peroxide solutions or hydrogen peroxide releasing agents can be used for tooth whitening. To enhance or accelerate the whitening process, heat-activation of the bleaching agent by light, heat or laser is described in the literature. The aim of the present review article was to summarize and discuss the available information concerning the efficacy, effects and side effects of activated bleaching procedures.

Existing literature reveals that activation of bleaching agents by heat, light or laser may have an adverse effect on pulpal tissue due to an increase of intra-pulpal temperature exceeding the critical value of 5.5 °C. Available studies do not allow for a final judgment whether tooth whitening can either be increased or accelerated by additional activation.

Therefore, application of activated bleaching procedures should be critically assessed considering the physical, physiological and patho-physiological implications.

Buchalla W, Attin T. External bleaching therapy with activation by heat, light or laser—A systematic review. Dental Materials, Vol 23, Issue 5, May 2007, Pgs 586-596

186. The narrow wavelength spectrum of which light cure system(s) is disadvantageous when the main photoinitiator is not Camphorquinone?

A. Plasma Arc
B. LED
C. LED and QTH

D. LED and Plasma Arc

Answer: D. LED and Plasma Arc

- LED and Plasma Arc (PAC) emit a narrow spectrum of light (at 450-490 nm), with the peak close to the peak of absorption of the Camphorquinone (468 nm)
- Specificity of the light emitted by LED is advantageous for polymerizing composites activated by the amine/Camphorquinone system
- The use of filter to limit the width of the wavelength is not mandatory for LED, although they induce lower heating to tooth during light-curing
- Current LED units promote considerable heating during the light activations of materials
- Plasma Arc is a high intensity light (saving time)
- The narrow wavelength spectrum of LED and PAC is disadvantageous when the main photoinitiator is not Camphorquinone (PPD, TPO)
- The activation of another photoinitiator system that absorbs light out of LED and PAC emitting wavelengths cannot efficiently be done. Therefore, the low degree of conversion can originate composites with deficient mechanical properties
- To induce composite polymerization and obtain high degree of conversion, it is necessary to provide the materials with appropriate energy density

Energy density = light intensity **x** exposure time

A. Correr, M. Sinhoreti, L. Sobrinho. Effect of the increase of energy density on knoop hardness of dental composites light-cured by conventional QTH, LED and xenon plasma arc. Dental Materials Area, Faculty of Dentistry of Piracicaba, State University of Campinas (UNICAMP), Piracicaba, SP, Brazil

Brazilian Dental Journal, Braz. Dent. J. vol.16 no.3 Ribeirão Preto Sept./Dec. 2005

187. This particular type of crown margin allows for burnishing and is suitable for cast restorations if a ledge or shoulder already exists possibly as result of caries, cervical erosion, or a previous restoration.

a. Chamfer
b. Shoulder
c. Bevel
d. Feather

ANSWER: C. Bevel

Margin Designs

- Feather edge (shoulderless crown)
  - Should be avoided because they do not provide adequate bulk at the margins
  - Lab technician overcontours resultant restoration
  - Facilitated impressions with copper bands because there was no ledge for band to catch
- Chisel edge margin
  - Variation of the feather edge margin
  - Associated with preparations with excessive angles of convergence
  - Facilitated impressions with copper bands because there was no ledge for band to catch
  - unacceptable
- Bevel

    - Suitable for cast restorations if a ledge or shoulder already exists possibly as a result of caries, cervical erosion, or a previous restoration
    - Allows cast metal margin to be bent or burnished against the prepared tooth structure
    - Minimizes marginal discrepancy caused by a complete crown that fails to seat completely
    - Protects the unprepared tooth structure from chipping
- Chamfer
    - Suitable for cast metal crowns and the metal-only portion of metal-ceramic crowns
    - Distinct and easily identified
    - Provides room for adequate bulk of material and development of anatomically correct axial contours
- Shoulder
    - Allows room for porcelain
    - Recommended for the facial part of metal-ceramic crowns
    - Should form a 90 degree angle with the unprepared tooth surface to avoid chipping
- Sloped shoulder
    - Alternative to the 90-degree shoulder for the facial margin of metal-ceramic crowns.
    - Reduces the possibility of leaving unsupported enamel but leaves sufficient bulk to allow thinning of the metal framework to a knife-edge for acceptable esthetics
- Shoulder with bevel
    - Recommended by some for the facial surface of a metal-ceramic restoration in which a metal collar is used.
    - Removes unsupported enamel and may allow some finishing of the metal

Rosenstiel et al. Contemporary fixed Prosthodontic, 4th edition: All ceramic restorations, 220

188. What type of composite material has the lowest modulus of elasticity?

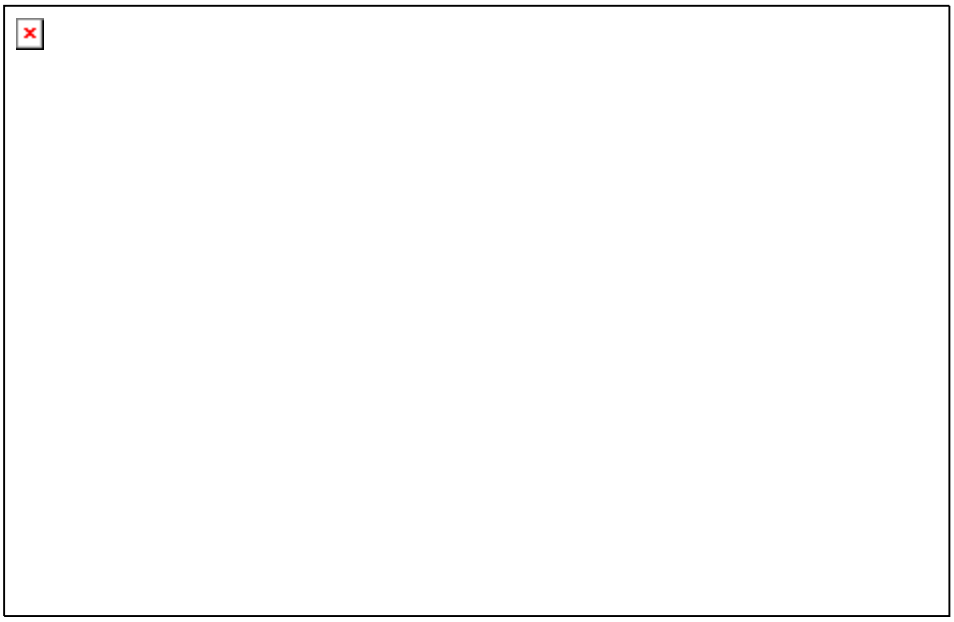
A. Nanofilled
B. Microfilled
C. Universal
D. They are all equal

ANSWER: B. Microfilled

Contemporary posterior resin-based composites contain a high percentage by volume of filler particles. This composition provides wear resistance and more stability. Thermal expansion and polymerization contraction are both reduced by increasing the volume percentage of filler particles. The increased filler content, needed for wear resistance, requires a decrease in matrix resin polymer, therefore allowing for a reduction in the amount of shrinkage that occurs upon polymerization. As the concentration of filler particles increases, the modulus of elasticity increases and tends to minimize shrinkage.

Pinkham, Jimmy R. Pediatric Dentistry: Infancy Through Adolescence, 4th Edition. Mosby, 2005. 20.4.2,

The Grandio (nanofilled) and Z-100 (universal) exhibit significantly higher dynamic and static moduli of elasticity than all the other materials tested. The two other nanofilled composites (Supreme and Grandio Flow) are not significantly different but they have a significantly higher dynamic elastic modulus than the other hybrid composites. The microfilled composites (A 110 and Durafill VS) as well as the Point-4 have the lowest dynamic moduli. The static modulus of elasticity of the Supreme and the Grandio Flow are not significantly higher than those of the other universal composites. Again, the microfilled composites show the lowest values.



Nanofilled
Universal
Nanofilled
Nanofilled
Universal
Universal
Universal
Microfilled
Microfilled

Beun S, Glorieux T, Devaux J, Vreven J, Leloup G. Characterization of nanofilled compared to universal and microfilled composites. Dental Materials 2007; 23, 1, 51-59.

189. Which of the following materials has a coefficient of thermal expansion most similar to natural tooth structure?

A. Amalgam
B. Glass Ionomer
C. ZOE Cement
D. Gold

Answer: B. Glass Ionomer

COTE – The change in length per unit length of a material for 1 C° change in temperature

Material	**Coefficient ($x10^{-6}$/°C)**
Inlay Waxes	350-450
Silicone impression material	210
Polysulfide impression material	140
Pit & fissure sealant	71-94
Acrylic resin	76
Mercury	60.6
Resin composites	14-50
ZOE cement	35
Amalgam	22-28
Silver	19.2
Copper	16.8
Gold	14.4
Porcelain	12.0
Tooth (crown)	11.4
Glass Ionomer type 2	10.2-11.4

Powers JM, Sakaguchi RL. Craig's Restorative Dental Materials. 12th edition, 2006.

190. When considering using a self etch adhesive vs. a total etch adhesive system, it has been shown that:

a. There is no statistical difference in Micro Tensile Bond Strength when bonding to enamel
b. The self etch systems show less MTBS when bonding to dentin
c. The total etch systems show less MTBS when bonding to dentin
d. The total etch systems show less MTBS when bonding to enamel

ANSWER: b. The self etch systems show less MTBS when bonding to dentin

PURPOSE: This investigation evaluated the microtensile bond strength (MTBS) of 3 one-step self-etching adhesives, 2 two-step self-etching adhesives, and a total-etch adhesive. A secondary objective was to evaluate the effect of an intermediary layer of elastic resin on the MTBS of 2 of the self-etching adhesives.
RESULTS: The 1-way ANOVA (P<.001) and Ryan-Einot-Gabriel-Welsh multiple range test (P<.05) showed significant differences between the mean MTBS values for several of the bonding agents tested. The Wald chi square test of the Weibull distribution showed significant differences between adhesives (P<.001).
CONCLUSION: Of the bonding agents tested, **significantly higher MTBS was obtained with the total-etch 2-stage adhesive. The results of this study suggest that there are similar bond strengths between the 1- and 2-bottle self-etch adhesives.**

Knobloch LA, Gailey D, Azer S, Johnston WM, Clelland N, Kerby RE. Bond strengths of one- and two-step self-etch adhesive systems. J Prosthet Dent. 2007 Apr;97(4):216-22.

191. When comparing packable and hybrid composites, the astute clinician can expect

a. A larger degree of marginal discoloration in the packable system over time
b. A greater occlusal wear pattern with hybrid composites over time
c. Both systems to lose surface texture at the same rate over time
d. A greater amount of color change with the packable system over time

ANSWER: c. Both systems to lose surface texture at the same rate over time

The clinical performance of packable and conventional hybrid resin composites in Class I restorations for a period of three years was compared using a randomized controlled double-blind clinical trial with self-matching design. A total of 50 pairs of Class I restorations were placed in 32 adult patients by one dentist in a self-matching prospective clinical trial. The paired teeth were divided into the TPH Spectrum/XenoIII (TS) restoration group and the Synergy Compact/One Coat (SC) restoration group according to a random number table. Application of the materials followed the manufacturer's instructions. The restorations were evaluated by two independent evaluators using US Public Health Service (USPHS)-Ryge modified criteria. Statistical analysis was performed using the McNemar's test with Yates' continuity correction. After three years, 40 pairs of restorations were available for evaluation. Four TS and two SC restorations failed due to fracture. Only one TS-restored tooth showed postoperative sensitivity at baseline and the symptom disappeared one week later. Alpha ratings of TS vs SC restorations were as follows: 95% vs 98% for color match, 85% vs 88% for marginal integrity, 88% vs 90% for anatomical form, 85% vs 83% for marginal discoloration, 88% vs 93% for occlusal contact. **For both materials, Alpha ratings were 88% for surface texture**. The three-year clinical performances of the two restorative materials were satisfactory and not significantly different for each of the parameters evaluated.
Shi L, Wang X, Zhao Q, Zhang Y, Zhang L, Ren Y, Chen Z. Evaluation of packable and conventional hybrid resin composites in Class I restorations: three-year results of a randomized, double-blind and controlled clinical trial. Oper Dent. 2010 Jan-Feb;35(1):11-9.

192. TEGDMA is added to resin composite material to:

A. enhance its antibacterial properties
B. decrease its polymerization shrinkage
C. increase its polymerization convergence
D. lowers its viscosity

ANSWER D. decrease its viscosity

- Most commonly used monomer in composites is bisGMA
- BisGMA has a very high viscosity, making it difficult to incorporate filler particles into it
- To reduce the viscosity, Bowen suggested replacing the bisGMA with another TEGDMA
- The advantage with TEGDMA is its lower viscosity and higher molecular flexibility
- Lower molecular weight of the TEGDMA contributes to increased shrinkage

Karl-Johan M. Söderholm, professor of dental biomaterials, Univ of Florida College of dentistry, 1999

193. In the detection of caries on the occlusal surface, the sensitivity and specificity of DiagnoDENT are:

A. More sensitive and specific than visual and radiographic examination
B. Less sensitive and specific than visual and radiographic examination
C. More sensitive but less specific than visual and radiographic examination
D. More specific but less sensitive than visual and radiographic examination

Answer: C

Sensitivity describes the ability to detect disease when it is actually present. (e.g. the ability to detect virus in the blood of an HIV+ patient)
False positives detect disease in a patient without the disease.

Specificity describes the ability to detect the absence of disease when it in fact is absent. (e.g. the ability to detect a negative PPD reading in a patient without exposure to TB)
False negatives fail to detect disease in a patient who has the disease.

DiagnoDENT had statistically higher sensitivity and lower specificity than visual examination. DiagnoDENT also had higher sensitivity and lower specificity than radiographic examination.
DiagnoDENT also had the highest inter- and intra-operator agreement of the three detection techniques, making it the most repeatable evaluation method.

DiagnoDENT generates numerical values from 0-99. It's performance greatly depends on what arbitrary cut-off points are used on this scale (e.g threshold of 10 vs. 50).

Attrill, Ashley. Occlusal caries detection in primary teeth: a comparison of DIAGNOdent with conventional methods British Dental Journal 190, 440 - 443 (2001)

194. What is the FDA approved use for Fluoride varnish in the United States?

A. Remineralization
B. Cavity Prevention
C. Cavity Liner
D. Dentin Sensitivity Treatment

ANSWER: C. Cavity Liner

Fluoride varnish first became available in the United States in 1991 when Duraflor received approval from the FDA for its use as a cavity varnish. In 1997, Duraphat also became available in the United States. Although approved for use as cavity varnishes and for the management of hypersensitivity, one of the most promising uses for fluoride varnish is in the prevention of tooth decay. The therapeutic use of fluoride varnish for caries prevention in the United States is called "off-label" use. This concept is sometimes confusing to those who may misinterpret it to mean that it is either illegal or unethical to use a product for an unapproved (as opposed to disapproved) use. However, the Federal Food, Drug, and Cosmetic (FD&C) Act does not limit the manner in which dentists may use approved drugs. It is often considered accepted medical or dental practice to use drugs for purposes other than that for which the drug originally received approval.

Fluoride varnish is considered by many to be ideally suited for application to the teeth of pediatric dental patients. Its ease of application makes it attractive for use with young or precooperative patients, when topical fluoride treatments are indicated. Both Duraflor and Duraphat are 5% NaF (2.26% fluoride ion) and are therefore more concentrated than most other professionally applied fluoride products. When used clinically, only a small amount is needed. Less than 0.5 ml of varnish is usually required to coat the teeth of a young child. Other potential uses for fluoride varnish include application to identified areas of high risk such as decalcified areas, deep pits and fissures that can't be sealed, and around orthodontic appliances in patients with poor oral hygiene.

Pinkham, Jimmy R. Pediatric Dentistry: Infancy Through Adolescence, 4th Edition. Mosby, 2005. 14.4.4.1.

195. All of the following are true about the configuration factor except:

A. Bonded surfaces restrict the 'flow' of the resin during polymerization while the non-bonded surfaces allow resin 'flow'
B. Low C-factors restrict flow and result in greater contraction and polymerization stresses
C. Incremental placement of composite helps to reduce these stresses
D. Rounding of internal angles reduces the C-factor

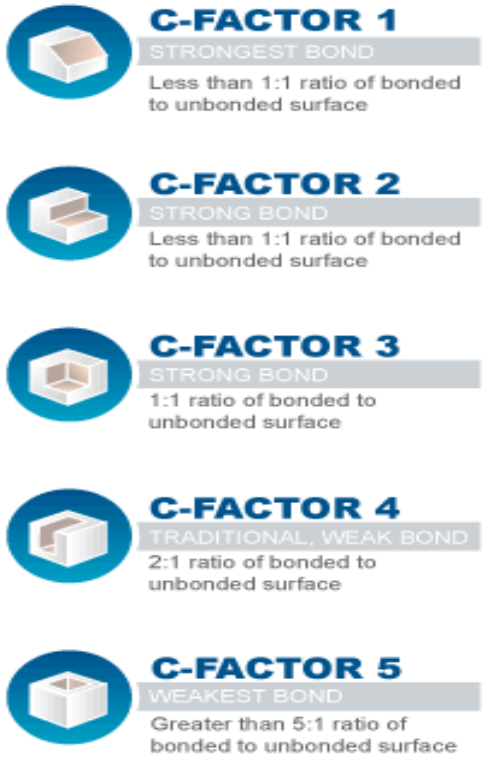
Answer: B. Low C-factors restrict flow and result in greater contraction and polymerization stresses

C-factor: The ratio of bonded (flow-inactive) to non-bonded (flow-active) surfaces

- Bonded surfaces restrict the 'flow' of the resin during polymerization while the non-bonded surfaces allow resin 'flow'
- High C-factors restrict flow and result in greater contraction and polymerization stresses
- Composite shrinks towards the middle when light cured unless bonded to a wall, then it has an affinity for that wall
- Incremental placement of composite helps to reduce these stresses

Examples:

- Shallow Class V Restorations: C < 1.0
- Class II and III Restorations: C = 1.0 – 2.0
- Class I Restoration: C = 5.0



Feilzer et al. Setting Stress in Composite Resin in Relation to Configuration of the Restoration. JDR November 1987 vol. 66 no. 11 1636-1639.

196. Chemical activation in self-cure composites is accomplished by:

A. an amine catalyst reacting with an organic peroxide to produce free radicals
B. an organic amine activating Camphorquinone to attack a carbon double bond
C. an organic peroxide activating Camphorquinone to attack a carbon double bond
D. An organic peroxide destabilizing the carbon double bond to produce free radicals

Answer: A. an amine catalyst reacting with an organic peroxide to produce free radicals

Light-cure composite:

- Most composites sensitive to 400-520 nm
- Light activation is accomplished with ***Blue*** light at peak wavelength of ***470 nm***
- Light is absorbed by ***Camphorquinone (CQ)*** photo-activator that is added to the monomer
- Reaction is accelerated by presence of an organic amine containing a carbon double bond
- The amine and the CQ are stable in the presence of the oligomer at room temperature as long as the composite is not exposed to light
- CQ adds a slight yellow tint to the uncured composite

Self-cure composite:

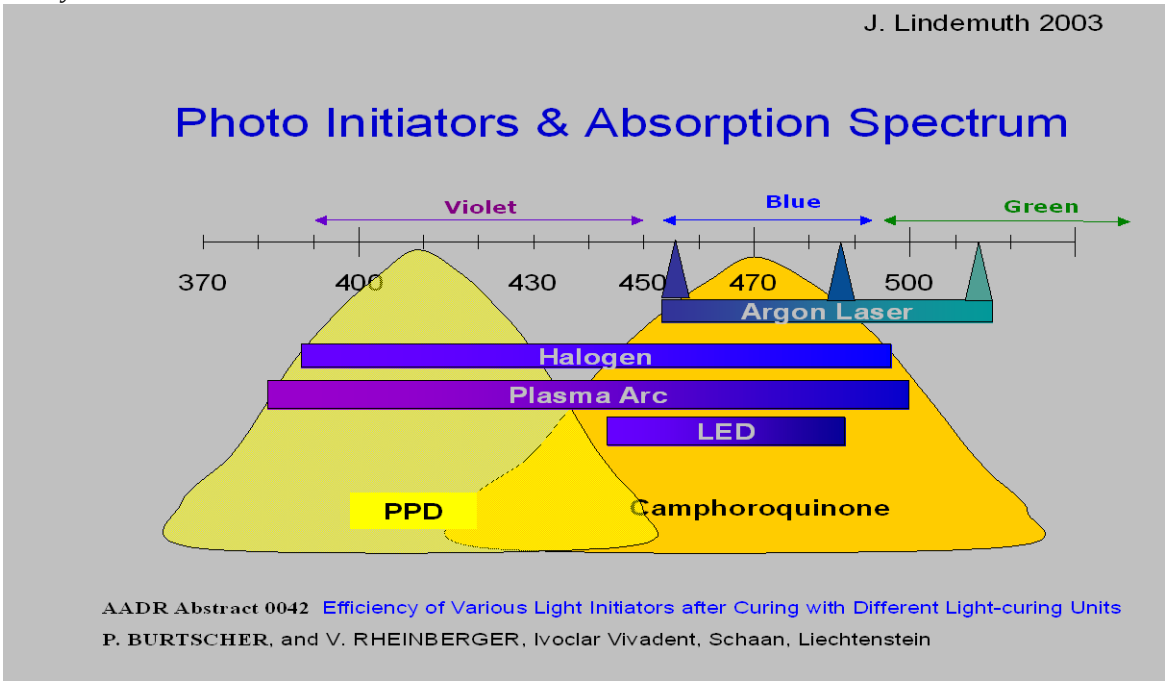
- Chemical activation is accomplished by an organic amine (catalyst paste) reacting with an organic peroxide (universal paste)
- This reaction produces free radicals, which in turn attack the carbon double bonds, causing polymerization

- Once the 2 pastes are mixed, the polymerization reaction proceeds rapidly

Dual-cured composites:

- Some composites like core and provisional materials
- A formulation that contain initiators and activators that allow light-activation followed by self-curing

Reference: *Powers, PhD, Sakaguchi, DDS, MS, PhD, "Craig's Restorative Dental Materials", Twelfth edition, Mosby 2006.*



197. The following is/are advantage(s) of Amalgam bonding

a. decreases microleakage over time
b. ability to preserve tooth structure
c. decreases post operative sensitivity
d. b and c

ANSWER b. ability to preserve tooth structure

The tooth-restoration interface in an amalgam restoration remains vulnerable to microleakage until it becomes sealed with the corrosion products of the amalgam. Traditionally, this initial seal has been provided by varnish. Brannstrom (1983) found that Copalite did not prevent bacterial leakage or growth on the cavity walls. Cavity varnish is effective in stopping marginal leakage on amalgam restorations until amalgam corrosion products precipitate and seal the gap between amalgam and the preparation wall. Glass ionomer cements, topical fluoride, and dentin adhesives as liners have shown favorable results in reducing microleakage. According to Vargas (1986) and Ben-Amar (1989), if adhesion of amalgam to the preparation is secured, microleakage can be minimized. A study by Machiori, Baratieri, de Andrada, Monteiro, & Ritter (1998) verified the effect of some liners on microleakage in amalgam restorations. Their in-vitro findings supported other reports (Staninec & Holt 1988, Turner, St. Germain, & Meiers 1995) that adhesive-lined restorations performed significantly better than varnish or topical fluoride-lined restorations on enamel microleakage.

Resin bonding systems have been shown to provide a better seal of the cavity wall than varnish and to inhibit microleakage at the interfacial gap. Amalgambond (Parkell), is a 4-META (4-methacryloxyethyl trimellitate anhydride) resin based adhesive, and one of the first to find success in the marketplace. It contains three other

components, in addition to the resin base; an activator, an adhesive agent, and a catalyst. In 1991, Cooley, Tseng, and Barkmeier studied its performance when used with a resin composite, an admixed alloy, and a spherical alloy. While the bond strength was modest, 3-4 MPa, the microleakage was significantly less with Amalgambond compared to cavity varnish. These findings were again reported in 1995 by Moore, Johnson, and Kaplan. However, after one-year there was no significant difference between the two. These results show that there is some resin breakdown over time that reduces the efficacy of the marginal seal, while the corrosive products from amalgam increases the efficacy of the amalgam sealed with varnish.

The type of amalgam used in a bonded amalgam has an effect on marginal integrity when using a bonding resin. High-copper amalgam alloys eliminate the corrosive phase and development of corrosive products required for an unbonded amalgam seal. Turner, St. Germain, & Meiers (1995) studied the microleakage of various bonding systems when used with either a spherical or admixed alloy. They found that bonding systems used in conjunction with amalgam had a significant reduction in microleakage when compared to unlined or varnish lined restorations. Thus the bonding of amalgam may minimize recurrent caries and postoperative sensitivity, but there was no significant difference for the comparison of the two alloy types. Diefenderfer and Reinhardt (1997) found, however, that a spherical alloy produced higher bond strengths than an admixed alloy when used in combination with a resin system. Do higher bond strengths result in improved microleakage?

The strength of the composite to enamel bond (20-25 MPa) is considered to be the best tooth-restorative bond presently available (Barkmeier, Shaffer, & Gwinnett 1986; Swift & Cloe 1993). The strength of the amalgam bonded to the tooth has been found to be much less and range from 3-10 MPa (McComb, Brown, & Forman 1995; Bagley, Wakefield, & Robbins 1994; Barkmeier, Gendusa, Thurmond, & Triolo 1994). It has been suggested that a shear bond strength of 21-24 MPa will eliminate microleakage at the tooth to bonding agent interface (Retief, Mandras, & Russell 1994). It has also been suggested that the use of a partially filled resin liner can significantly reduce marginal microleakage (Fortin, Swift, Denehy, & Reinhardt 1994). In an in-vitro study by Diefenderfer and Reinhardt (1997), they compared the shear bond strengths of various combinations of amalgam alloys (spherical or admixed) and five adhesive resin bonding agents (filled or unfilled). The more highly filled resins tended to produce higher bond strengths than the unfilled resins. Their results found that the combination of a filled adhesive resin with a spherical amalgam alloy produced the highest bond strength of 14 MPa. As previously stated, the higher the bond strength, the better the marginal seal, but this is yet to be proven in vivo.

To study the efficacy of bonded amalgam restorations, clinical studies are of interest to the dentist. As reported earlier, the results to date are limited and reveal little advantage over conventional amalgam restorations. In a one-year clinical evaluation of bonded amalgam restorations, Mahler, Engle, Simms, and Terkla (1996) found no benefit from the use of a bonding agent in traditional Class I and II preparations. Others have reported favorable performance (Ruzickova, Staninec, Setcos, & Mach 1996; Staninec, Eakle, Silverstein, Marshall, & Artigua 1995). The center of the debate seems to stem around the surface treatment of the tooth and the variations in technique. According to Staninec (1996), in a letter to the American Dental Association, he stated that the bond of the bonding resin to the tooth is not likely to fail under amalgam, any more than under resin composites. The bond of the resin to amalgam, however, has not been studied widely, particularly in the long-term.

While amalgam restorations to teeth that were restored with traditional forms of mechanical and pin retention, Belcher & Stewart (1997) reported equal results for the two groups. Amalgam bonding was proven to be as effective as traditional amalgam preparations and tooth structure was conserved. The best retention was gained by the use of macromechanical retention and an adhesive liner. Still, two-years is not long-term. In a three-year continuation study, Olmez, Cula, & Ulusu (1997) reported clinically acceptable performance of resin-lined amalgam restorations to resin composite restorations. The longest clinical performance study to date (Browning, Johnson, & Gregory 2000) finds the marginal adaptation of bonded amalgam restorations to be equivalent to that of restorations placed using traditional techniques. This 42-month study used conventional preparations modeled after accepted principles for retention and resistance, but did not evaluate the performance of the adhesive liner on weakened teeth.

A review of the literature provides a measure of confidence to the practitioner that the proper placement of bonded amalgam restorations leads to a clinically acceptable result, comparable to the clinical results of traditional amalgam

procedures. In weighing the benefits of bonded amalgam restorations vice conventional amalgams, the added cost of the bonding step must be factored. It is important that the dental profession be sure that the additional costs of using an adhesive in conjunction with an amalgam restoration be justified by the benefit to the patient.

198. Which of the following cementation approaches most likely provide the best retention for a fiber post?

A. No surface conditioning and GI cement
B. Polyacrylic conditioning and RMGI cement
C. Self-etching adhesives and light-cure resin cement
D. Etch and rinse and self-cure resin cement

Answer: D. Etch and rinse and self-cure resin cement

- Acidic monomers in self-etch adhesives and self-etching resin cements are not strong enough to etch the smear layer to from hybrid layers along the canal walls
- Dual-cured and self-cured adhesives and composites are favored for fiber post cementation
- Self-adhesive cements are relatively new; minimal data and studies are available on performance
- Post surface silanation may be an important factor in improving bond of the resin cement
- Non-resin cements do not provide chemical adhesion

Monticelli, Ferrari, Toledano, "Cement system and surface treatment selection for fiber post luting", Med Oral Patol Oral Cir Bucal. Mar 2008, Vol 20, No 5:523-525.

<u>Water-Based Cements</u>	
GI	MCR, ACR (alumina, zirconia coping), Cast posts, Ortho bands
RMGI	MCR, ACR (alumina, zirconia coping), Cast posts, Ortho bands
Zinc Phosphate	MCR, SSC, long-term provisional, Ortho bands
Zinc Polyacrylate	MCR, long-term provisional, Ortho bands
<u>Resin-Based Cements</u>	
Composites resins	MCR, ACR, Fiber posts, Inlays, Onlays, veneers, Ortho brackets
Compomers	MCR, ACR (alumina, zirconia coping), Ortho brackets
<u>Oil-Based Cements</u>	
Zinc-Oxide	High strength base, provisional restorations, root canal sealer
Zinc-Oxide NE	Provisional restorations, root canal sealer, Surgical dressing

Powers, Sakaguchi, "Craig's Restorative Dental Materials", Twelfth edition, Mosby 2006.

199. Which is the correct sequence for cementing a porcelain veneer

a. Etch the fitting surface of porcelain with Phosphoric acid, apply a priming agent, etch the enamel with Phosphoric acid, apply DBA to the prepared tooth, seat the restoration with resin cement.

b. Etch fitting surface of porcelain with Hydrofluoric acid, apply a priming agent, etch the enamel with Phosphoric acid, apply DBA to the prepared tooth, seat the restoration with resin cement.

c. Etch the fitting surface of porcelain with Hydrofluoric acid, apply a silaning agent, etch the enamel with Phosphoric acid, apply DBA to the prepared tooth, seat the restoration with resin cement.

d. Etch the fitting surface of porcelain with Phosphoric acid, apply a silaning agent, etch the enamel with Phosphoric acid, apply DBA to the prepared tooth, seat the restoration with resin cement.

Answer C

Introduction
An ideal luting cement would have: easy manipulation, low film thickness, long working time with rapid set, low solubility, high compressive and tensile strengths, high proportional limit, adhesion to tooth/restoration, anticariogenicity, biocompatibility, and translucency or radiopacity. Physical properties should be taken into consideration *along with* handling characteristics, technique sensitivity, and results from long term clinical trials (1). Most cements are formed by an acid-base reaction. Liquids may be phosphoric acid, polyacrylic acid, or eugenol. Powders are either zinc oxide or aluminosilicate glass. **Resin cements, however, are not acid-base formed but utilize BIS-GMA or urethane dimethacrylate resins.** Cements can be classified into five groups: phosphate bonded, polycarboxylate bonded, phenolate bonded, resin cements, and glass ionomer/hybrid cements.

Phosphate bonded
Zinc Phosphate is a combination of zinc oxide powder and phosphoric acid. It is one of the oldest (1877) and most widely used cements. It is considered the standard by which all other cements are measured. **Zinc phosphate cement has the advantages of high compressive strength and a thin film thickness of less than 25 microns.** It is good for general/routine use and recommended for long span fixed partial dentures due to its rigidity. Fleck's (Mizzy) is an example of zinc phosphate cement.
Zinc Phosphate's disadvantages include: low initial pH, which can cause post cementation sensitivity, lacks chemical bond to tooth structure, and no anticariogenic effect. Several techniques can be employed to improve the characteristics of zinc phosphate cement. Mixing the cement on a cool glass slab will increase working time and allow incorporation of more powder to liquid. An increased powder to liquid ratio will increase compressive strength and decrease solubility. The technique of "slaking" can increase working time by mixing small increments of powder to liquid and waiting ~60 seconds between mixed increments. Water contamination of zinc phosphate should be avoided while it is setting, as this increases the solubility of the cement. Avoid using zinc phosphate on teeth that are already sensitive.

Polycarboxylate bonded
Zinc Polycarboxylate was developed by Dennis Smith in 1968 and was one of the first chemically adhesive formulas (adheres primarily to enamel) (2). This cement is formed when zinc oxide powder is mixed with polyacrylic acid. The advantages of zinc polycarboxylate are its kindness to pulp tissue and ability to bond to tooth structure. This cement has a short working time and the tooth surface requires conditioning (acid etch) prior to cementation. Although there is approximately 4% stannous fluoride in the powder, this cement is not considered anticariogenic. The amount of fluoride released by this cement is only 10-15% compared to glass ionomer cements. Zinc polycarboxylate may also plastically deform resulting in failure after a few years (2). This cement is recommended for single units and short span fixed partial dentures. It is also recommended for hypersensitive teeth and when preparations come close to the pulp. Durelon and Tylok Plus are examples of polycarboxylate cements.

Phenolate bonded
Zinc Oxide Eugenol (ZOE) was developed by Dr. J. Foster Flagg in 1875 (3). Zinc oxide powder reacts with water, forming zinc hydroxide. Zinc hydroxide then reacts with the eugenol to make zinc eugenolate. Zinc eugenolate is a very soluble cement because it can hyrolyze back into zinc hydroxide and eugenol (i.e. a reversible reaction). ZOE cement is relatively weak in strength when compared to other cements. Orthoxybenzoic acid can be added to the eugenol and alumina or poly (methyl methacrylate) can be added to the powder to increase the cement's strength. This cement is known to have an obtunding effect on the pulp. Because of its weak strength and high solubility, zinc oxide eugenol cement may be questionable as a permanent luting agent. This cement may be used on very sensitive teeth that have excellent retention/resistance form. Fynal is a reinforced zinc oxide eugenol cement

Resin cements
Resin cements are composed of urethane dimethacrylate (UDMA) resin that can contain from 30 to 80% filler particles. The advantages of resin cement are its high compressive strength and low solubility. **The disadvantages of resin cements include: high film thickness and potential irritating effects to the pulp. Problems with film thickness have been reduced by using smaller filler particles and diluent monomers (4).**
Resin cements are polymerized in three different ways: light-activated, chemically-activated, and dual-activated (light and chemical activation). Light-activated cements are best suited for restorations that transmit light, like

porcelain veneers or restorations <1.5mm thick. Chemically-activated resins can be used for cementation of non light transmitting restorations. Examples are all-ceramic restorations, resin-bonded fixed partial dentures, ceramic inlay/onlay (>2.5mm) or full metal restorations. Light transmitting restorations of moderate thickness (1.5-2.5mm) can be cemented with a dual-activated cement when light penetration is limited. **Adhesive resin cements are claimed by their manufacturers to chemically bond to tooth structure and metals. This is due to adhesive monomers in these cements containing MDP, HEMA, and 4-META (5-8).**

It is important to adequately light cure dual-activated cements because only a portion of the total cure comes from the chemical curing (9). Chemically activated resins need a period of approximately 24 hours before they are fully cured. In general, it is safe to function on restorations cemented with these cements after one hour. Provisional restorations cemented with eugenol-based cements may detrimentally affect bonding of resin cements because of eugenol acting as a free-radical scavenger (10). However, several researchers have found no effect on resin-dentin bond strengths because of eugenol contamination (11,12). Resin cements are suitable for luting porcelain, cast ceramic, and composite restorations and recommended for teeth that have inadequate retention/resistance after preparation. Examples of resin cements include PANAVIA, Calibra, and Variolink.

Glass ionomer/hybrid cements

Glass Ionomers can be considered as a hybrid of silicate and carboxylate cements (aluminofluorosilicate glass powder combines with polyacrylic acid liquid). The fluoride content of the powder ranges from 10-23%. Examples include Fuji I (GC Corp.) and Ketac-Cem (3M ESPE AG).

The advantages of glass ionomer cement include its ability to chemically bond to tooth structure, anticariogenic effect, high compressive strength, low solubility, and a coefficient of thermal expansion similar to that of tooth structure. This cement's disadvantages include: potential post-cementation sensitivity because of low initial setting pH and the setting reaction sensitivity to moisture contamination/dessication. These cements are excellent for general prosthodontic use. Fluoride release may be beneficial for some patients. Avoid using glass ionomer with hypersensitive teeth.

The self-cured hybrid cements (also known as resin-modified cements) are a new form of glass ionomer cement that incorporate resin filler particles with the glass ionomer cement. These hybrid cements have increased tensile strength and are not as brittle as glass ionomer cements. Examples of these cements include Principle (Caulk) and FujiCEM (GC Corp.) Hybrid cements release the same amount of fluoride as glass ionomer cements and are less soluble and less sensitive to moisture contamination when setting (4, 13). It is not recommended to cement certain all-ceramic restorations, like veneers and pressed ceramics, with hybrid cements because of the potential for post-cementation fractures. It is believed that these cements undergo hydrolytic expansion after water sorption, which leads to crack propagation in the overlying restoration.

Post cementation sensitivity

A resin-based desensitizer can be placed on the prepared tooth prior to cementation to decrease the potential for post cementation sensitivity when using zinc phosphate or glass ionomer cements. These desensitizers should not adversely effect crown retention (14).

Indications and contraindications for luting agent types

Restoration	Indicated	Contraindicated	
Cast crown, PFM crown, fixed partial denture	1,2,3,4,5,6	-	Key:
Pressed ceramic crown, ceramic inlay, ceramic veneer, resin bonded FPD	1	2,3,4,5,6	1=Resin cement
Patient with history of post-treatment sensitivity	3,6	1	2=Glass ionomer
Crown or FPD with poor retention	1	2,3,4,5,6	3=Reinforced ZOE
Cast post and core	1,2,4,5	3,6	4=Resin reinforced glass ionomer 5=Zinc phosphate 6=Zinc polycarboxylate

Petrich A, VanDercreek J, Kenny K. Clinical Update: Dental Luting Cements. Naval Post Graduate Dental School, USN. March 2004

Etched Porcelain, composite, and pressed ceramic veneers

The only difference in this procedure for porcelain veneers from the composite veneers is the need to condition the internal surface of each veneer with a silane primer just before applying the resin-bonding agent. The silane acts as a coupling agent, forming a chemical bond between the porcelain and the resin. It also improves wettability of the porcelain. The primary source of retention with porcelain veneers still remains the etched porcelain surface itself. Only a modest increase in bond strength results from silanation of the procealin; however, it's recommended because it may reduce marginal leakage and discoloration.

The clinical technique for placing pressed ceramic veneers, such as those made by IPS Empress, is not markedly different from that for feldspathic porcelain veneers (slightly greater tooth reduction).

Sequence of cementing veneers

1. Etching the fitting surface of the ceramic with hydrofluoric acid
2. Applying a silane coupling agent to the ceramic
3. Etching the enamel with phosphoric acid
4. Applying a resin bonding agent to the etched enamel and silane
5. Seating the restoration with a composite resin luting agent

Rosenstiel et al. Contemporary fixed Prosthodontic, 3rd edition: All ceramic restorations

200. Microfilled composites typically have a particle size of _____ microns, whereas Hybrid composites range from _____ microns _.

A. 0.6 – 1.0 ; 8 – 12 microns
B. 8 - 12 ; 0.6 – 1.0
C. 0.04 – 0.4 ; 0.5 - 3.0
D. 0.5 - 3.0 ; 0.04 – 0.4

ANSWER: C. 0.04 – 0.4 ; 0.5 - 3.0

The practical amount of filler that can be incorporated into a resin is greatly influenced by the total filler surface area, which is a function of particle size, with surface area increasing as size decreases for a constant volume of filler. Colloidal silica particles, because of their extremely small size, have extremely large surface areas ranging from 50 to as much as 400 m^2 per gram. The silica surfaces form polar bonds with the monomer molecules; this inhibits their flow, increases the viscosity, and "thickens" the resin paste, even with very small amounts. Because of this effect, the microfilled composites contain only 20 to 59 vol% colloidal silica as the only inorganic component. The remainder is pulverized, precured resin, the so-called "organic" filler with a particle size between 5 and 30 µm. In many composite formulations colloidal fillers are added in amounts of less than 5 wt% solely to increase paste viscosity and to enhance cavity packing consistency. Hybrids, with 10 to 15 wt% colloidal silica, can be filled to only approximately 5% less inorganic filler content than the small-particle composites.

Characteristic/ property	Unfilled acrylic	Traditional	Hybrid (small-particle)	Hybrid (all-purpose)	Microfilled	Flowable hybrid	Packable hybrid	Enamel	Dentin
Size (µm)	—	8–12	0.5–3	0.4–1.0	0.04–0.4	0.6–1.0	Fibrous	—	—
Inorganic filler (vol%)	0	60–70	65–77	60–65	20–59	30–55	48–67		
Inorganic filler (wt%)	0	70–80	80–90	75–80	35–67	40–60	65–81	—	—
Compressive strength (MPa)	70	250–300	350–400	300–350	250–350	—	—	384	297
Tensile strength (MPa)	24	50–65	75–90	40–50	30–50	—	40–45	10	52
Elastic modulus (GPa)	2.4	8–15	15–20	11–15	3–6	4–8	3–13	84	18
Thermal expansion coefficient (ppm/° C)	92.8	25–35	19–26	30–40	50–60	—	—	—	—
Water sorption (mg/cm^2)	1.7	0.5–0.7	0.5–0.6	0.5–0.7	1.4–1.7	—	—	—	—
Knoop hardness (KHN)	15	55	50–60	50–60	25–35	—	—	350–430	68
Curing shrinkage (vol%)	8–10	—	2–3	2–3	2–3	3–5	2–3	—	—
Radiopacity (mm Al)	0.1	2–3	2–3	2–4	0.5–2	1–4	2–3	2	1

Table 15-2 Properties of Composite Restorative Materials

Anusavice, KJ. *Phillips' Science of Dental Materials, 11th Edition*. W.B. Saunders Company, 2003. 18.3.5.

201. The design of tooth preparation for fixed prosthodontics must adhere to certain mechanical guidelines. The following is incorrect regarding retention and resistance principles of crown preparations

A. Premolar crowns are more retentive than molar crowns of the same height and taper
B. Premolar crowns are less retentive than molar crowns of the same height and taper
C. Premolar crowns are more retentive than molar crowns of the same height
D. Premolar crowns are more retentive than molar crowns of the same taper

Answer B.

Principles of Tooth Preparation

- Retention is the prevention of removal along the path of insertion.
- Resistance is the prevention of the removal in a oblique or lateral direction

Retention factors to be considered are:

- Magnitude of the dislodging forces
  - **Are small compared to resistant forces**
  - exceptionally sticky food
- Geometry of the tooth preparation
  - Minimizing taper effectively limits the number of directions in which a cast crown can be dislodged
  - Maximum retention is obtained if a tooth preparation has parallel walls
  - Limited path of withdrawal
  - **The recommended convergence angle is 6 degrees which is a very slight taper**
    - **The angle between the hands of a clock showing 12:01 is 5 ½ degrees**
  - Surface area (increased surface area results in increased retention)
    - Long axial walls are more retentive than short axial walls
    - **Molar crowns are more retentive of premolar crowns of similar taper (same height)**
- Roughness of fitting surface of restoration
  - Airborne particle abrasion of 50 μm of alumina increases in vitro retention by 64%
- Materials being cemented
- Type of luting cement(resin-bonded cements are the most retentive)
- Film thickness of the luting agent

Resistance factors to be considered are:

- Magnitude and direction of the dislodging forces (must be able to withstand oblique and normal axial forced)
- Geometry of the tooth preparation
  - the relationship between preparation height, or diameter, and resistance to displacement is approximately linear
  - addition of pinholes and grooves reduce rotational movement
- Physical properties of the luting agent
  - Must have compressive strength > 70 Mpa

Rosenstiel, Land, Fujimoto. Contemporary Fixed Prosthodontics *4th edition.*

202. Pretreatment with a weak polyalkenoic-acid conditioner for 10-20 seconds when using traditional Glass Ionomers has been shown to:

a. Have no effect on bond strength so it does not matter if it is used
b. Becomes a part of the bond and increases bond efficiency
c. Will cause continued etching effect if not completely rinsed off
d. Cause no demineralization effect because of the smear layer barrier
ANSWER b. Have several effects and becomes a part of the bond

Glass ionomers remain the only materials that are self-adhesive to tooth tissue, in principle without any surface treatment. **Pre-treatment with a weak polyalkenoic- acid conditioner significantly improves their bonding efficiency,** however. Hence, this glass ionomer approach can be achieved following a one or two step application procedure. The additional conditioning step is most important when a coarse diamond is used and a thicker, more compact smear layer is pronounced.
In general, a polyalkenoic-acid conditioner is applied for 10-20 seconds and then rinsed off, and the tooth is air-dried without dehydrating the surface. The polyalkenoic-acid pretreatment is much milder than traditional phosphoric-acid treatment, and the exposed collagen fibrils are not completely denuded of hydroxyapatite. The increase in bonding efficiency must be attributed to:
1. A cleaning effect, by which loose cutting debris is removed
2. **A partial demineralization effect, by which the surface area is increased and microporosities are created**
3. Chemical interaction of the polyalkenoic acid with residual hydroxyapatite.

A network of hydroxyapatite-coated collagen fibrils interspersed with pores is typically exposed up o 1 micron in depth. **TEM and XPS examination have demonstrated that polyalkenoic-acid conditioners cannot be completely rinsed off**. **Up to a 0.5 micron thick layer, often referred to as the gel phase, remains attached to the tooth surface after conditioner has been rinsed off.**

Summitt, J.B. et al, Fundamental of Operative Dentistry; 3rd edition, 2006 pgs 227-230

203. BiTine ring in the Palodent Sectional Matrix System is designed to :

A. provide an interproximal wedging force to enhance contact formation
B. to ensure an ideal proximal contouring of the restoration
C. be used only for class II and class III composite restorations
D. eliminate the need for incremental placement of the resin composite material

Answer: A. provide an interproximal wedging force to enhance contact formation

- Palodent sectional matrix system is designed to be used for the placement of posterior class II resin composite restorations
- A number of difficulties have been associated with placement of posterior composite restorations to include obtaining adequate interproximal contacts
- BiTine ring in the *Palodent* Sectional Matrix System is designed to:

    1. Apply an interproximal wedging force to enhance contact formation
    2. Aid in proximal contouring of the restoration

- Procedure:

    1. Apply the BiTine ring interproximally between the tooth to be prepared and the adjacent tooth pre-operatively for initial seperation
    2. After completion of the preparation, the BiTine ring is removed
    3. The sectional matrix and wedge are applied
    4. Matrix is burnished against the adjacent tooth
    5. Compound is added to the BiTine ring tines and replaced
    6. Resin composite restoration is placed

http://www.caulk.com/assets/pdfs/products/AutomatrixPalodentPDFU_English.pdf

204. Porcelain fused to metal restoration account for 80% of restorations. The following is true regarding the porcelain-to-metal bond

a. The CTE of porcelain must be less than metal for retention of porcelain to a metal substructure
b. The coefficient of thermal expansion (CTE) of the metal and porcelain must be equal
c. The CTE of metal must be less than porcelain for retention of porcelain to a metal substructure
d. The CTE of has no effect on the porcelain-to-metal bond

Answer A.

There are three main divisions of dental ceramics: (1) predominatly glassy materials, (2) particle-filled glasses, and (3) polycrystalline ceramics. Highly esthetic dental ceramics are predominantly glassy, and higher strength substructure ceramics are generally crystalline. Most dental ceramics are a variation of either feldspathic porcelain or of a derivation of silica glass. Feldspathic porcelain is available a high, medium and low fusing types. Only the low fusing type is used in dental restorations. This porcelain is associated with metal-ceramic restorations.

Porcelain fused to metal restorations account for 80% of restorations. PFMs or all-ceramic restorations must be able to withstand normal vertical masticatory forces form 565 MPa in the molar region and 155 MPa in the incisor region.

The porcelain-metal bond consists of: a (1) chemical bonding (2) mechanical interlocking (3) compression and (4) Van der Wall forces.

The metal is finished, cleaned , and oxidized at 1900 F. to form an oxide layer. Opaque porcelain is baked onto the metal to mask the metal and form the porcelain-metal bond. Body and incisal porcelain are baked on at a slightly lower temperature under 25" Hg vacuum drawing any trapped air out of the restoration. The final restoration is characterized and glazed at a slightly higher temperature without vacuum, resulting in a smooth, finished surface.

The thickness of the oxide layer is critical for porcelain retention. If it is too thin, the chemical bond is insufficient to hold porcelain. If the oxide layer is too thick, the porcelain will fail through that weak layer.

Alloys which oxidize readily, such as predominantly base metals, must be handled correctly to avoid too thick of an oxide layer.

Compression of the porcelain on a PFM is a main factor in porcelain retention to the metal substructure. The coefficient of thermal expansion (CTE) of the metal and porcelain must be closely matched, such as that **the metal has a slightly larger CTE than the associated porcelain.** Upon cooling this results in a slightly greater amount of contraction than the porcelain. Consequently, the porcelain is compressed. Each layer from opaque to body to enamel has a slightly lower CTE (i.e. opaque has the greatest CTE of any porcelain layer). **Typically porcelain has CTEs in the range of 13.0-14.0 x 10^{-6}/degree C. and alloys between 13.5 -14.5 x 10^{-6}/degree C.**

Kelly, J.R. Dental ceramics: current thinking and trends; Dentl Clin N Am 48 (2004) 513-530

Santulli,G.A CAPT. The Santulli Manual; MPDS 253 Fixed prosthodontics syllabus

205. Which of the following statements are true regarding caries remaining under a sealant.

A. Sealants significantly reduce bacteria levels in cavitated lesions.
B. Sealants cannot block access to fermentable substrates.
C. There are significant increases in bacteria under sealants.
D. Bacteria that persist under sealants can still produce acid.

ANSWER: A. Sealants significantly reduce bacteria levels in cavitated lesions.

Sealants were effective in reducing total bacteria counts in caries lesions. The reduction increased with time since sealant placement. At the last follow-up, there was a 100-fold decrease in mean bacteria counts in two studies and a 1,000-fold decrease in the remaining two studies. Sealants also reduced bacterial cultivability. On average, 47 percent of sealed lesions had viable bacteria (median = 50 percent) compared with 89 percent of unsealed lesions (median = 100 percent). When we excluded deep dentinal lesions, these values decreased to 27 percent for sealed lesions (median = 8 percent) and 83 percent in unsealed lesions (median = 83 percent) (Table 3). These data suggest that a limited number of cultivable organisms may persist in some lesions but that their numbers are small. The effect of sealants on levels of *S. mutans* and lactobacilli, which have been suggested as primary cariogens in pit-and-fissure caries, also was strong in two of the three studies that examined this outcome. These results provide more specific information about the preventive effects of sealants at the surface level.

Bacterial activity, as measured by a reduction in $\log_{10}$ mean VBC or the percentage of cultivable samples, decreased with time in all studies that had multiple follow-up periods. Results of one study showed a linear decrease in mean $\log_{10}$ VBC across time. Since bacteria decreased across time, the findings of this review suggest that retained sealants deprive bacteria of access to nutrients in the substrate. Furthermore, it appears that bacteria that persist under sealants cannot produce acid when isolated from the carbohydrate substrate and, thus, adequately sealed lesions are unlikely to progress. Another analysis of studies included in the larger systematic review that supported this report on bacteria levels under sealants found that sealing noncavitated lesions reduced the probability of lesion progression by more than 70 percent.

Our findings do not support reported concerns about poorer outcomes associated with inadvertently sealing caries and should lessen practitioners' reluctance to provide sealants—an intervention proven to be highly effective in preventing caries. Indeed, although study conduct varied considerably, there were no findings of significant increases in bacteria under sealants.

We found that sealants significantly reduced bacteria levels in cavitated lesions, but that in some studies,

low levels of bacteria persisted. These findings support those of a recent meta-analysis that sealants prevented caries progression. In combination, these two sets of findings suggest that when sealants are retained, and thus access to fermentable substrates is blocked, bacteria do not appear capable of exerting their cariogenic potential.

Ella MO, et al. The Effect of Dental Sealants on Bacteria Levels in Caries Lesions: A Review of the Evidence. J Am Dent Assoc 2008, Vol 139, No 3, 271-278.

206. All of the following statements are true concerning the medical model of caries except:

A. Caries is a bacterial infection caused by specific bacteria
B. Caries risk and activity provide a diagnosis & prognosis leading to an individual's treatment plan
C. White spot lesions are treated with excavation and restored with glass ionomer for fluoride release
D. Reduction of risk levels for at-risk patients is paramountAnswer: C. Treating white spot lesions with excavation and restoration with glass ionomer for optimal fluoride release

Answer: C. White spot lesions … optimal fluoride release

Caries is a bacterial infection caused by specific bacteria. Before cavitation, caries is reversible multifactoral. Caries risk and activity provide a diagnosis & prognosis leading to a treatment plan.

Patients receive treatment using a medical model consisting of 4 steps: bacterial control; reduction of risk levels; reversal of active sites by remineralization; and follow-up and maintenance.

Steinberg S. A paradigm shift in the treatment of caries. Gen Dent. 2002 Jul-Aug;50(4):333-8.

Minimum intervention, or MI, is the modern medical approach to management of caries. The principles are really very simple. The first principle is to assess and identify any carious risk factors early on. The second principle is to minimize these risk factors in order to help prevent caries. The third and final principle is conserving as much tooth structure as possible.

The medical model to approaching white spot lesions is to aid the remineralization process so that these will not turn into actual cavities by treating them a product such as Recaldent™ (Casein Phosphopeptite (CPP) and Amorphous Calcium Phosphate (ACP)).

http://www.dentistrytoday.com/hygiene/1164

The most reliable predictor of high caries risk to the permanent dentition is the caries experience in the primary dentition, with caries in primary molars having the highest predictive value.

Whitaker EJ. Primary, secondary and tertiary treatment of dental caries: A 20-year case report. Am Dent Assoc 2006 137(3): 348-352.

207. Which of the following statements is false regarding concerning a high caries risk protocol.

A. Prescribe a Chlorhexidine rinse for two weeks.
B. Reduce the quantity and frequency of carbohydrate consumption.
C. Recommend chewing 2 pieces of xylitol gum for 5 minutes three times a day.
D. Reinforce the importance of their annual recall.

ANSWER: D. Reinforce the importance of their annual recall.

The recall should be about every three months.

BOX

Sample protocol for the patient at high risk of developing caries.

PLAQUE CONTROL

- Brush at least twice a day with soft toothbrush and fluoride toothpaste.
- Floss once a day.
- The correct technique for brushing and flossing is essential in removing plaque. Bacterial plaque causes both tooth decay (caries) and gum (periodontal) disease. Brushing and flossing remove plaque.

FLUORIDE TOOTHPASTE

- Use it. Fluoride helps reverse early tooth caries.
- Toothpaste freshens breath, removes stains and contains fluoride.

PROFESSIONALLY APPLIED FLUORIDE

- Fluoride varnish or gel applied four times in one month helps reverse early caries.

DIETARY MODIFICATION

- Reduce quantity and frequency of consumption of sugary or starchy foods, especially between meals.
- Do not sip sodas, sports drinks, coffee or tea with cream or sugar for long times.
- Avoid eating hard candy, cough drops, breath mints and starchy foods routinely.
- Diet soda does not promote tooth caries, but it is acidic and can dissolve tooth enamel.

PRESCRIPTION FLUORIDE TOOTHPASTE

- Concentrated fluoride toothpaste for use at home may be recommended.

CHLORHEXIDINE PRESCRIPTION MOUTHRINSE

- Rinse with one tablespoon for 30 seconds, then spit out. Do not eat or drink for 30 minutes after use. Use for two weeks. Wait 30 minutes between using chlorhexidine rinse and brushing with toothpaste.

XYLITOL GUM

- Chew one or two pieces for five minutes after meals three times per day. The xylitol sugar is destructive to caries-causing bacteria; other sugarless gums are not as effective.

RECALL APPOINTMENTS

- Frequency: every three months until you are caries-free.
- Recall is a critical part of your caries prevention program.

FLUORIDE MOUTHRINSE

- Rinse with one tablespoon for 60 seconds, then spit out. Do not eat or drink for 30 minutes after use.

Bartoloni JA, Chao SY, Martin GC, DDS, Caron GA. Dental caries risk in the U.S. Air Force. JADA Nov 2006; Vol. 137; 1582-91.

208. Recommendations in an all ceramic inlay/onlay preparation include all of the following except:
a. 1.5mm reduction in all excursions from opposing dentition
b. Butt joint margins
c. 1.0-1.5mm isthmus width
d. No centric contacts coinciding with occlusal margins
e. Bevels are contraindicated

ANSWER c. 1.0-1.5mm isthmus width

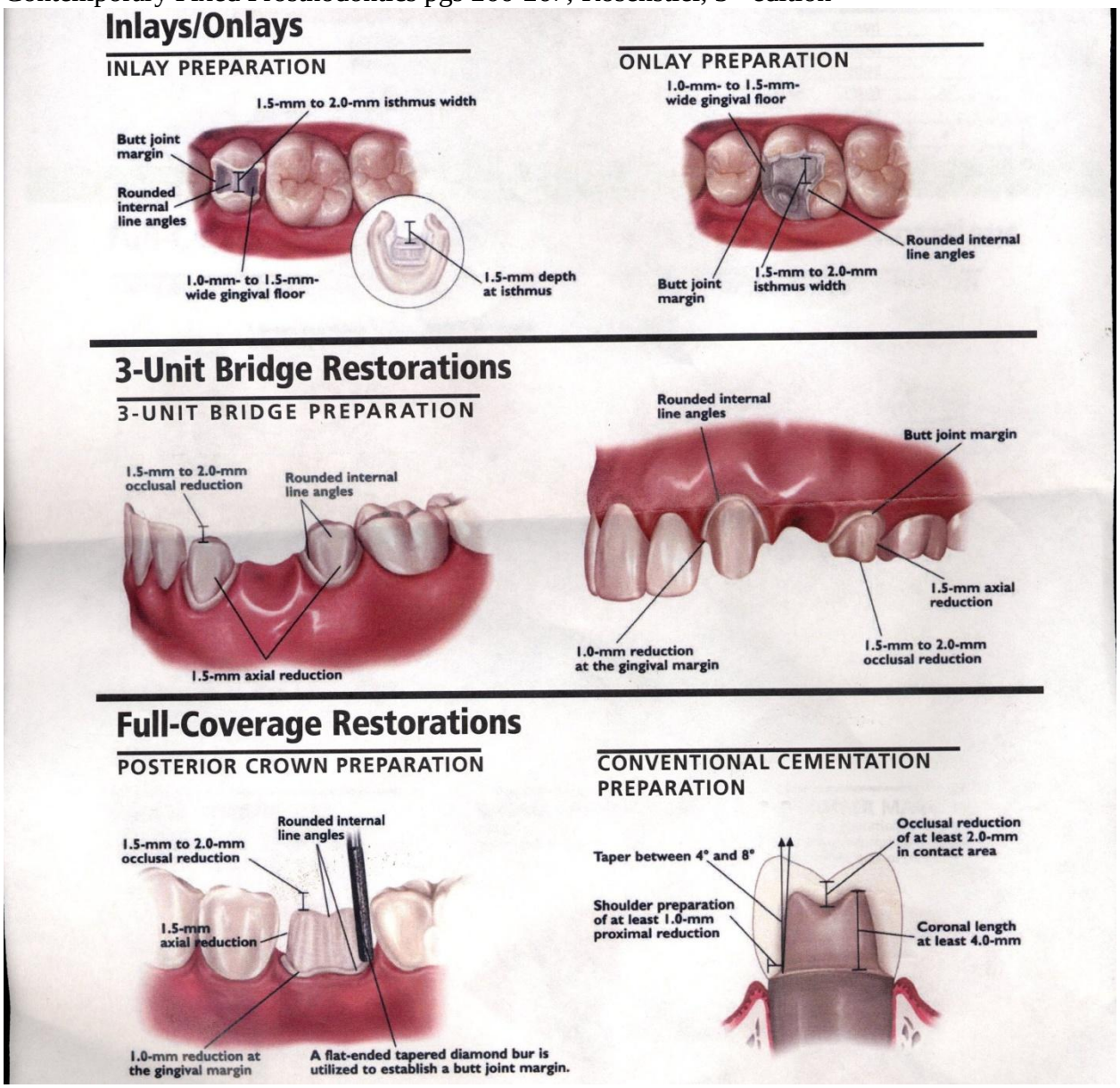
Rubber dam is recommended for visibility and moisture control when preparing for all ceramic inlays and onlays. Step by step procedure.
1. Mark centric contact before isolation. **Margins should not fall on centric contact points**. This will avoid chipping or wear of the luting resin.
2. Prepare outline form, excavate caries as with metal inlays or onlays. Because of the resin bonding, axial wall undercuts can sometimes be blocked out with resin-modified glass ionomer cement, preserving additional enamel for adhesion. However, undermined enamel should always be removed.
3. The central groove reduction (1.8mm) follows the anatomy of the unprepared tooth. This will provide additional bulk for the ceramic.
4. **Areas to be onlayed need 1.5mm of clearance in all excursions** to prevent ceramic fracture.
5. Extend the box to allow a minimum of 0.6mm of proximal clearance for impression making.
6. The margin should be kept supragingival which will make cementation and polishing much easier.
7. The width of the gingival floor of the bow should be approximately 1.0.mm.
8. Round all internal line angles. Sharp angles lead to stress concentrations and increase the likelihood of voids during the luting procedure.
9. Use a 90 degree butt joint for ceramic inlay margins. **Bevels are contraindicated** because bulk is needed to prevent fracture. A distinct heavy chamfer is recommended for ceramic onlay margins.
10. Check after the rubber dam is removed that 1.5mm of clearance is achieved in all movements. To be sure, one can measure the thickness of the provisional restoration with a dial caliper.

All ceramic posterior preparation guide. From Ivoclar vivadent. **www. Ivoclarvivadent.com**
Which includes lithium disilicate and Leucite reinforced ceramics.

Inlay preparation
1. But joint margin
2. Rounded internal line angles
3. 1.0-1.5mm wide gingival floor
4. 1.5mm depth of isthmus
5. **1.5-2.0mm isthmus width**

Onlay preparation
1. Butt joint margin
2. 1.0-1.5mm wide gingival floor
3. **1.5-2.0mm isthmus width**
4. Rounded internal line angles

Contemporary Fixed Prosthodontics pgs 266-267; Rosenstiel, 3rd edition



209. Which of the follow are the most common reasons for failure of ceramic inlays or onlays?

A. Debonding and marginal breakdown
B. Fracture and debonding
C. Fracture and marginal breakdown
D. Debonding and method/material of cementation

Answer: C. Fracture and marginal breakdown

- Two types of failure are most common with esthetic Inlays and Onlays:
    1. Bulk fracture
    2. Marginal breakdown
- Bulk fracture sometimes occurs in the area of cuspal coverage, particularly if the restorative material is less than 2.0 mm thick
- It also occurs at the isthmus adjacent to marginal ridge, where the porcelain is poorly supported by tooth structure
- Marginal ditching is a common finding in inlays and onlay because resin cements are heavily filled and wear more quickly than the adjacent restorations or tooth structure, especially if the marginal fit is poor to start with
- Hybrid resin cements wear faster than microfilled resin cements (Kawai, 1994)

Reference: *Summit, Robbins, Hilton, Schwartz, Santos, Jr., "Fundamentals of Operative Dentistry; A Contemporary Approch", third edition, 2006.*

210. Wettability and hydrophilization are important characteristics of elastomeric impression materials. The following is true regarding polyether vs. addition silicone impression materials.

a. Polyethers are considered truly hydrophilic due to their increased wettability
b. Addition and polyether impression materials have contact angles less than 45 degrees.
c. Surfactants have been added to polyethers by manufacturers to reduce the contact angle
d. Polyethers have a high degree of wettability due to polar oxygen atoms most impression materials produced acceptable detail under wet and dry conditions.

Answer: D

Wettability and hydrophilization of elastomeric impression materials

Wettability may be assessed by measuring the advancing contact angle of water on the surface of the set impression material or by using a tension meter to measure forces as the material is immersed and removed. Of all the impression materials, only hydrocolloids can be considered truly hydrophilic. All of the elastomeric impression materials possess advancing and receding contact angles greater than 45 degrees. There are, however, differences in wetting among and within types of elastomeric impression materials. Traditional addition silicone is not as wettable as polyether. When mixed gypsum products are poured into addition silicone, high contact angles are formed, making the preparation of bubble-free models difficult. Surfactants have been added to addition silicones by manufacturers to reduce the contact angle, improve wettability, and simplify the pouring of gypsum models. This class with improved wetting characteristics is most accurately called hydrophilized addition silicone. Most commonly, nonionic surfactants have gained importance in this area. These molecules consist of an oligoether or polyether substructure as the hydrophilic part and a silicone-compatible hydrophobic part. The mode of action of these wetting agents is believed to be a diffusion-controlled transfer of surfactant molecules from the polyvinylsiloxane into the aqueous phase, thereby altering the surface tension and therefore greater wettability of the polyvinylsiloxane is observed. This mechanism differs from polyether, which possess a high degree of wettability because their molecular structure contains polar oxygen atoms, which have an affinity for water. Because of this affinity, polyether materials flow onto hydrated intraoral surfaces are therefore cast with gypsum more easily than are addition silicones. This affinity also allows polyether impressions to adhere quite strongly to soft and hard tissues. By observing water droplets on impression surfaces, it has been shown that hydrophilized addition silicones and polyethers are wetted the best, and

condensation silicones and conventional addition silicones the least. Polyether was shown to wet significantly better than hydrolyzed addition silicones for both advancing and receding contact angles. From a clinical standpoint, most impression materials produced acceptable detail under wet and dry conditions. Polyethers produced slightly better detail than did addition silicones , and were generally unaffected by the presence of moisture, whereas detail decreased some for addition silicones under wet conditions, even if hydrophilized.

Powers J.M and Sakaguchi R.L. Craig's Restorative Dental Materials 12th edition

211. Which dentin hypersensitivity modality matches the mechanism of action?

A. Lasers – uses electricity to enhance diffusion of ions into the tissues
B. Oxalates - reduce dentin permeability and occlude tubules
C. Ionto-phoresis – depolarizes the nerve
D. Lasers - crystal precipitation within the tubules.

ANSWER: B. Oxalates - reduce dentin permeability and occlude tubules

Fluoride. Fluorides such as sodium fluoride and stannous fluoride can reduce dentin sensitivity. Fluorides decrease the permeability of dentin in vitro, possibly by precipitation of insoluble calcium fluoride within the tubules.

Potassium nitrate. Potassium nitrate, which usually is applied via a desensitizing toothpaste, also can reduce dentin sensitivity when applied topically in an aqueous solution or an adhesive gel. Potassium nitrate does not reduce dentin permeability in vitro, but potassium ions do reduce nerve excitability in animal models.
Oxalate. Oxalate products reduce dentin permeability and occlude tubules more consistently in laboratory studies than they do in clinical trials.
Calcium phosphates. Calcium phosphates may reduce dentin sensitivity effectively. Calcium phosphates occlude dentinal tubules in vitro and decrease in vitro dentin permeability.
Adhesives and resins. Because many topical desensitizing agents do not adhere to the dentin surface, their effects are temporary. Stronger and more adhesive materials offer improved and longer-lasting desensitization … claim to occlude tubules in hypersensitive dentin.
Ionto-phoresis. This procedure uses electricity to enhance diffusion of ions into the tissues. Dental iontophoresis is used most often in conjunction with fluoride pastes or solutions and reportedly reduces DH.

Lasers. The effectiveness of lasers for treating DH varies from 5 to 100 percent, depending on the type of laser and the treatment parameters. Studies have reported that the neodymium:yttrium-aluminum-garnet (YAG) laser, the erbium:YAG laser and galium-aluminium-arsenide low level laser all reduce DH, but the reductions were not significantly different from those of a placebo or positive controls.
Miscellaneous treatments. A large number of anecdotal reports support alternative approaches for tooth desensitization. Although these reports are not truly evidence-based, they may apply to some clinical situations. For example, periodontal surgery involving coronally positioned flaps reportedly eliminates DH in extensively exposed root dentin. If the DH is associated with an abfraction lesion, occlusal adjustment may be effective.

Orchardson R, Gillam DG. Managing dentin hypersensitivity. JADA 2006; 137, 7, 990-998.

212. Which of the following is not an appropriate finish line for an all-ceramic crown?
A. Heavy chamfer
B. Shoulder
C. Chamfer
D. Radial shoulder

Answer: C. Chamfer

A *chamfer* finish line is appropriate for an all metal restoration (AMR). It exhibits the least amount of stress so that the cement underlying it will have less likelihood of failure. A *heavy chamfer* is used to provide a 90-degree cavosurface angle with a large radius rounded internal angle. The heavy chamfer provides better support for a ceramic crown than does a conventional chamfer, but it's not as good as a shoulder. A bevel can be added to the heavy chamfer for use with a metal restoration. The *shoulder* is the finish line of choice for the all-ceramic crown. The wide ledge provides resistance to occlusal forces and minimizes stresses that might lead to fracture of the porcelain. It produces the space for healthy restoration contours and maximum esthetics. The sharp, 90-degree internal line angle concentrates stress in the tooth & is conductive to coronal fracture. It is not generally used for cast metal restorations. The *radial shoulder* is a modification of the shoulder finish line. The initial instrumentation of the ledge is accompanied with the same flat-end tapered diamond used for the classic shoulder. A small-radius rounded internal angle is instrumented by an end-cutting parallel-sided carbide finishing bur, & finishing is completed with a specially modified bin-angle chisel. The cavosurface angle is 90 degrees, & shoulder width is only slightly lessened by the rounded internal angle. Stress concentration is less in the tooth structure than with a classic shoulder, and support for ceramin restoration walls is good. The *shoulder with a bevel* is used as a finish line in a variety of situations. It's utilized as the gingival finish line on the proximal box of inlays & onlays, and for the occlusal shoulder of onlays & mandibular three-quarter crowns. It can also be used for the facial finish line of metal-ceramic restorations where gingival esthetics are not critical, or where a shoulder is already present, or with a preparation with extremely short walls.

Shillinburg et al. Fundamentals of Fixed Prosthodontics, 3rd edition. 1997.

213. The following are characteristics of an ideal ferrule except:

A. It should encompass 360 degrees around the tooth
B. It should comprise solid tooth structure
C. No more than 25% of the margin can be in restorative material
D. It should be at least 1-2mm in height

Answer: C. No more than 25% can be in restorative material

When restoring the endodontically treated tooth, it is common to place a post in the prepared canal due to loss of tooth structure.

According to Sorensen and Engelman, one millimeter of coronal tooth structure above the crown margin substantially increased the fracture resistance of endodontically treated teeth. They suggested that this "ferrule effect" be defined by a 360-degree metal crown collar surrounding parallel walls of dentine and extending coronal to the shoulder of the preparation

Sorenesn JA and Engelman MJ. Ferrule design and fracture resistance of endodontically treated teeth. J of Pros Dent. Vol 63, Issue 5, 1990, 529-536.

Libman & Nicholls suggested that to achieve the full benefits of the ferrule effect it should be a minimum of 1.5 mm in height and have parallel dentine walls, totally encircle the tooth, end on sound tooth structure and avoid invasion of the attachment apparatus of the tooth.

Libman WJ, Nicholls JI. Load fatigue of teeth restored with cast posts and cores and complete crowns. Int J Prosthodont. *1995;8:155–161*

The most important anti rotatory feature for posts and cores is the placement of a ferrule effect.

Hemmings KW, King PA, Setchell DJ. Resistance to torsional forces of various post and core designs. J Prosthet Dent. *1991;66:325–329.*

Even if a dowel core is placed in the tooth, the root will remain susceptible to fracture without the crown encircling the tooth apical to the core. This *ferrule effect* around the tooth protects it from fracture by the dowel from within. In fact, if tooth structure is lost "only" to the level of the epithelial attachment, minor extrusion may be desirable to permit access to enough tooth structure apical to the finish line to produce a ferrule effect. Burying the finish line subgingivally will not solve the problem.

The distance that the tooth is to be extruded is calculated by adding 1) the distance from the most apical point of fracture or caries to the alveolar crest (if the damage extends subcrestally), 2) 2.0mm for the biologic width, and 3) at least 1.0mm to prevent placement of the crown margin too far subgingivally. If the damage is flush with the alveolar crest, a minimum of 3.0mm of extrusion would be required.

Shillinburg et al. Fundamentals of Fixed Prosthodontics, 3rd edition. 1997.

214. The effective depth of microabrasion when removing isolated white or brown spots attributed to fluorosis is:

a. 0.1mm into dentin
b. 2mm into enamel
c. 0.3mm into enamel
d. 1mm into enamel

ANSWER: c. 0.3mm into enamel

Overview. Tooth-whitening methods include the use of peroxide bleaching agents to remove internal discolorations or abrasive products to remove external stains. Peroxide bleaching procedures are completed by the dentist in single or multiple appointments, or by the patient over a period of weeks to months using custom trays loaded with a bleaching agent. Both methods are safe and effective when supervised by the dentist. Microabrasion is indicated for the removal of isolated discolorations that often are associated with fluorosis. Whitening toothpastes remove surface stains only through the polishing effect of the abrasives they contain.

Isolated brown or white areas of enamel discoloration on otherwise normal teeth, which often are attributed to fluorosis, can be treated with microabrasion if the discoloration is less than a few tenths of a millimeter deep. Microabrasion is performed by applying an abrasive slurry of silicon carbide and hydrochloric acid using a manual or handpiece-driven rubbing action. This slow removal of enamel is easier to control than that performed using rotary instruments. The depth of the discoloration cannot be known until attempts are made to remove it. If the discoloration is too deep, it cannot be removed using microabrasion, and a restorative solution should be considered.
The mechanism of color improvement appears to be the removal of discolored surface enamel and the creation of a highly reflective enamel surface that may mask any remaining discoloration. The combined benefits of enamel microabrasion followed by home tooth whitening using carbamide peroxide have been reported in case studies. The combined regimen is reported to be most effective in patients who have prominent white areas on teeth that are yellowish or that have darkened with age. In vitro results support the application of neutral sodium fluoride after microabrasion is completed to create enamel that is significantly more resistant to demineralization than untreated enamel.

Sarrett DC; J Am Dent Assoc. 2002 Nov;133(11):1535-8; quiz 1541.Tooth whitening today.
Roberson, Heymann, Swift. Sturdevant's Art & Science of Operative Dentistry. 4th edition. p. 605-613
Summitt, Robbins, Hilton, Schwartz. Fundamentals of Operative Dentistry. 3rd edition. p. 455-457

Microabrasion and macroabrasion are subtractive procedures that physically remove tooth structure. Acid removes mineral from surface enamel to the depth of 22-27 microns. This sufficiently weakens the tooth structure so that the abrasive material can remove the superficial layer of tooth structure.
Macroabrasion is removal of superficial enamel with finishing burs.

215. Which one of the following is not recommended for treatment of fluorosis stain

A. Micro/Macro abrasion
B. Veneers
C. Internal bleaching
D. Composite restorations

Answer: C. Internal bleaching

- Diagnosis of dental fluorosis is difficult and must be differentiated from amelogenesis imperfecta and molar-incisal hypo mineralization
- Most important data will be the familial history, place of residence, chronology of discoloration appearance
- Treatment options for fluorosis varies with severity
- Depending upon severity, treatment option varies:
    1. Micro/Macro abrasion
    2. Bleaching
    3. Composite restorations
    4. Veneers
    5. Full crowns

Sherwood A. Fluorosis varied treatment options, J of Cons Dent, 2010 Jan – Mar; 13(1): 47–53.

216. The retention of dental crowns can be increased by

A. Tin plating the intalglio surface of feldspathic porcelain restorations
B. Tin plating the intalglio surface of base metal restorations
C. Tin plating the intalglio surface of high noble metal restorations
D. Tin plating the intalglio surface of composite restorations

Answer C.

Composite resin cements have shown the highest bond strengths. The surface treatment of metals such as electrolytic tin-plating, silica coating, and aluminum oxide particle abrasion have all been shown to increase the resin-to-metal tensile bond strength. **The greatest bond strength of resin cement to noble metal alloys have been obtained when the metal was abraided with aluminum oxide particles and tin-plated.** The tin-plating/conventional resin cement combination demonstrated the highest bond strength and the conventional glass-ionomer cement provided the lowest. Tin-plating has not been advocated for use with conventional glass-ionomer cements, because the bond of the conventional glass-ionomer would likely have minimal effect due to the low diametral tensile strength of the cement.

The bond between luting cements and the noble metal surface is presumed to be predominantly micromechanical in nature. **Microabrasion with 50-um aluminum oxide particles increases the surface for bonding, produces micromechanical retention, and enhances surface wetting.**

The silica coating system (Rocatec) is a tribo-chemical silica-coating system that used a coating of ceramic bonding agent and a silane solution.

Tin–plating a high noble alloy surface increased the alloy-cement bond primarily through enhanced micromechanic retention. Electroylytic tin-plating produces a thin layer of tin crystals on the alloy surface.

Swartz MS, Davis RD, Overton JD, Tensile bond strength of resin-modified glass-ionomer cement to microabraded and silica-coated or tin-plate high noble ceramic alloy. J Prosthodont 2000:;9;195-200.

Rocatec is a tribochemical method for silicatising surfaces. Tribochemistry involves creating chemical bonds by applying mechanical energy. This supply of energy may take the form of rubbing, grinding or sandblasting. There is no application of heat or light which would normally be the case with chemical reactions.

The Rocatec system consists of a coating unit (Rocatector delta or Rocatec junior), microblasting sand Rocatec Pre (cleaning and activating the surface), coating sand Rocatec Plus or Rocatec Soft and silane solution 3M ESPE Sil (resin primer).

First of all the surface to be coated is cleaned by blasting with 110 μm aluminium oxide sand (high-purity aluminium oxide, Rocatec Pre) and then roughened. This activates the surface and creates a uniform pattern of surface roughness which is ideal for the ensuring microretentive anchorage of the resin. This is followed by tribochemical coating of the microblasted surface with silica-modified aluminium oxide (Rocatec Plus or Rocatec Soft). The sand described above (Pre) is coated with a thin layer of SiO2 (silica or silicon dioxide) (110 μm or 30 μm aluminium oxide + SiO2 = Rocatec Plus or Rocatec Soft). Apart from ceramicising the surface, the impact of the particles also causes a certain amount of abrasion. With substrates which are highly susceptible to abrasion (e.g. thin electroplated metal edges) it is therefore advisable to use the 30 μm blast grit (Rocatec Soft) because it is less abrasive, but produces the same adhesive strength (Pfeiffer 1993). By contrast with the classic Rocatec Plus, with Rocatec Soft the medium grain size of the carrier aluminium oxide is reduced from 110 μm to 30 μm.
Ceramization of the blasted surface takes place when the grains hit the surface. This means that locally very high temperatures are caused by the transfer of impulses and energy (but only locally - macroscopic measurement shows no heat formation!). The affected surfaces of the substrate and grit in the atomic and molecular ranges are excited to such an extent that a so-called triboplasma forms.
The SiO2 is impregnated into the surface up to a depth of 15 μm and at the same time fused to the surface in islands (see Figs. 4 and 6). The high level of energy which is required is created by the acceleration of the grain to a velocity of up to 1000 km/h due to the geometry of the blast nozzle and a blast pressure of at least 2.8 bar.

The coated surfaces still have to be conditioned in order to be able to create a bond with the resin. This next step is silanisation with 3M ESPE Sil. A chemical bond between the inorganic silicatised surface and the organic resin can only be made in this way.
This resin may be a veneering resin, an opaquer or any other methacrylated monomer system (MMA, Bis-GMA, etc.).
The resulting anchorage roughly corresponds to the chemical bonding of silanised fillers in composite. Such bridging of a chemical bond between inorganic and organic constituents can only by achieved by a special molecule, namely a dual molecule which can react with silicatised surface at one end and with methacrylate groups (double bond) at the other.

Rocatec Bonding, Product profile 3M ESPE

217. Which porcelains are capable of being etched?

A. Feldspathic, pressed lithium disilicate, pressed leucite, alumina oxide
B. Feldspathic, pressed lithium disilicate, pressed leucite, zirconium oxide
C. Feldspathic, pressed lithium disilicate, pressed leucite
D. pressed lithium disilicate, pressed leucite, alumina oxide, zirconium oxide

ANSWER: C. Feldspathic, pressed lithium disilicate, pressed leucite

1. It appears that low-pressure sandblasting, followed by 60 to 120 seconds of etching with 9% to 10% HF, has scientific support and validity when treating conventional powder/liquid stackable porcelains. A variation that also appears effective is sandblasting followed by 4% to 5% HF applied for four to five minutes.

2. In the case of a popular pressable ceramic (Empress), the recommended treatment protocol of5% HF applied for 60 seconds has scientific support and should be followed.

Specific manufacturer recommendations for many of the other pressable and/or high leucite containing ceramics are vague, do not exist, or could not be found and/or verified by this author. Some ceramic manufacturers shift responsibility by simply recommending following the directions of the manufacturer of whatever HF-etching gel or liquid is being utilized. As a result, specific treatment protocols appear to be largely speculative. Perhaps these are the restorations many ceramists stated (to this author) that they simply etch until the "surface looks frosty." While this is certainly not very scientific, and likely not optimal, in the absence of specific guidelines, it may be the best ceramists and dentists have in some situations.

3. Two lithium disilicate-based ceramics replaced a now defunct product. The manufacturer of these products recommends a very specific etching time of only 20 seconds with 5% HF and studies exist supporting this protocol.

4. High-strength alumina and zirconia core-based crowns cannot be etched with HF. As a result, it is not possible to "bond" these restorations with conventional HF/silane treatment. Silica coating, followed by silane application, has been shown to be a viable alternative.

Alex G. Preparing Porcelain Surfaces for Optimal Bonding. *Functional Esthetics & Restorative Dentistry 2008; Series 2,Number 1, 38-49.*

218. Which of the following is not true concerning enamel beveling for composite restorations:

A. Bevels should routinely be placed gingival to the CEJ for additional retention when extensive tooth structure has been removed
B. Bevels should be placed at an angle approximately 45 degrees to external tooth surface
C. Can be placed on proximal cavosurface margins of a class 2 prep, if the proximal box is wide faciolingually to gain more retention
D. May enable the restoration to blend more esthetically with the coloration of the surrounding tooth structure

Answer: A. Bevels should routinely be placed gingival to the CEJ for additional retention when extensive tooth structure has been removed

Advantages

- Facilitates better marginal sealing & bonding
- The ends of the enamel rods are exposed to beveling and are more effectively etched
- Increase in etched surface area results in a stronger enamel-to-resin bond, which increases retention and reduces marginal leakage and discoloration.
- Incorporation of a cavosurface bevel may enable the restoration to blend more esthetically with the coloration of the surrounding tooth structure.

Characteristics/Nuggets

- Beveled at angle approximately 45 degrees to external tooth surface
- *Rarely* used for posterior composite restorations and not placed on areas of potential heavy occlusal forces, however Class I restorations may be beveled resulting in a 0.25-0.5 mm wide bevel.
- A bevel placed on an occlusal margin can result in thin composite on the occlusal surface in areas of potentially heavy contacts, potentially resulting in fracture or wear.
- Usually bevels aren't placed on the facial or lingual of the proximal box. Also not placed on proximal margins if beveling results in excessive extension of cavosurface margin.
- However, bevels can be placed on the proximal facial and lingual margins if the proximal box is already wide faciolingually & if it's determined that additional retention form may be necessary. Proximal bevels should not be placed if extensive extension of margins is required.
- A bevel is usually not placed on the gingival margin, although it may be necessary to remove any unsupported enamel rods at the margin because of gingival orientation of the rods.
- For moderate and large Class III beveled preparations, all accessible enamel margins are usually beveled, except for the gingival margin. No bevel should be placed on cementum.
- Bevels may not be recommended on lingual surface margins that are in areas of centric contact or subjected to heavy forces due to less wear resistance of composite.

Roberson, Heymann, Swift. Sturdevant's Art & Science of Operative Dentistry, 4th edition. 2002.

219. The main clinical method to detect anterior interproximal caries is:

a. Orthodontic separation
b. Fiber Optic Transillumination (FOTI)
c. The DIAGNOdent instrument
d. separation and a PVS impression

ANSWER: B. Fiber Optic Transillumination (FOTI)

For the detection of proximal lesions in anterior teeth, the **fiber optic Transillumination technique, a fine light, coned down to a 0.5mm diameter, is transmitted through a contact area**. A lesion appears as a dark shadow. It is difficult, however, to discriminate between demineralization extending just into enamel and that progressing further into dentin, especially in the posterior areas. The use of an orthodontic separator has been advocated in some cases to allow the dentist to see more clearly and to gently feel for a break in the enamel surface.

Summitt, J.B. et.al. Fundamentals of Operative Dentistry. 3rd edition. Pg 87-88

Abstract Fiber optic transillumination (FOTI) has been employed during the course of a 3-yr clinical dentifrice trial which initially involved 3003 children. At the initial examination, a subgroup of 813 13-yr-olds, and at the following annual visit, 2247 14-yr-olds, were examined using a 150 W lamp and 0.5 mm diameter probe. Routine clinical and radiographic examinations were performed separately. **Compared to the clinical scores for anterior teeth, FOTI detected an additional 64% of interproximal lesions at the first visit while, for the larger number of children at the second visit, the increase in lesion detection level using FOTI was 37%**. For the posterior teeth the comparable figure at the second examination was 92%. When FOTI data were compared to radiographic data for more than 52 000 posterior interproximal surfaces, FOTI could only detect 17% of radiographic Grade 2 lesions and 48% Grade 3 lesions. Thus any assumption that FOTI diagnoses may be a substitute for bitewing radiography appears premature

K. W. Stephen, et al. Comparison of fiber optic transillumination with clinical and radiographic caries diagnosis, 2006.

220. Of the following, which is not a condition/situation in which professionally applied topical fluoride treatments are indicated?

a. Orthodontic Treatment
b. In a patient with a high cariogenic diet
c. Caries Risk Recall Visits
d. A patient with a history of Head and Neck Radiation

Answer: b. in a patient with a high cariogenic diet

Existing evidence indicates that cario-static activity of fluoride involves several different mechanisms. The ingestion of fluoride results in its incorporation into the dentin and enamel of unerupted teeth; this makes the teeth more resistant to acid attack after eruption into the oral cavity. In addition, ingested fluoride is secreted into saliva. Although it is present in low concentrations, the fluoride is accumulated in plaque, whereas it decreases microbial acid production and enhances the remineralization of the underlying enamel. Fluoride from Saliva is also incorporated into the enamel of newly erupted teeth, thereby enhancing enamel calcification (frequently called enamel maturation), which decreases caries susceptibility. As a topically applied therapeutic agent, fluoride is effective in preventing future lesion development, in arresting or at least slowing the progression of active cavitated lesions, and in remineralizing active incipient lesions. Topical fluoride also has some antimicrobial properties.

Every Patient Communal Water Fluoridation	Most effective in preventing caries	Age	< 0.3 ppm	0.3-0.6ppm	> 0.6ppm
		Birth-6 mos	0	0	0
		6 mos- 6yrs	0.25mg	0	0
		3yrs-6yrs	0.50mg	0.25mg	0
		6yrs-16yrs	1.0mg	0.50mg	0

Fluoride Dentifrices	2nd most effective	Sodium Fluoride	Home – 0.32%; RX	**Every patient** **High Caries Risk**	
Topical Fluorides	**Recalls, Mod-High caries Risk, Ortho, H/N RAD, Xerostomia, Institutionalized**	Gels Foams Varnishes	Routinely recommended at recalls	Gels – 4mins Foams – 4 mins	Incipient Lesions, Arresting Cavitated lesions
Home Fluoride Rinses and Gels	**Mod-High Caries Risk** **Ortho, H/N RAD, Xerostomia, Institutionalized**	NAF Rinses most common	OTC 0.5%NAF		Contraindicated in children with Fluorinated water

APF (10)(%)(1000)	*ppm*
1.0%	**10,000**
1.23%	**12,300**
NaF (4.5)(%)(1000)	**ppm**
0.05%	**225**
0.20%	**900**
0.44%	**1,980**
1.0%	**4,500**
1.1%	**4,950**
2.0%	**9,000**
5.0%	**22,500**
SnF_2 (2.4)(%)(1000)	**ppm**
0.40%	**960**
0.63%	**1,512**

McDonald, Avery and Dean; Dentistry for the child and adolescent; 8th edition, pgs 223-231
Summitt, et al. Fundamentals of operative Dentistry; 3rd edition

"ADA.org:A-Z Topics: Fluoride and Fluoridation". American Dental Association. http://www.ada.org/prof/resources/topics/fluoride.asp. August 2009.

221. According to ADA specification No. 2, which type of investment material is used for casting inlays and crowns in a high noble metal?

a. Type I calcium sulfate-bonded investment
b. Type I phosphate-bonded investment
c. Type II calcium sulfate-bonded investment
d. Type II phosphate -bonded investment

Answer: A. Type I calcium sulfate-bonded investment

- Casting investment is a mixture of:

1. Refractory material quartz, cristobalite
2. Binder material calcium sulfate, phosphate
3. Other chemicals sodium chloride, potassium sulfate

- According to ANSI/ADA specification No. 2 for gypsum-bonded casting investments applies to two different types of investments suitable for casting dental restorations of gold alloys

Type I For casting inlays and crowns
Type II For casting complete and partial denture bases

Powers, PhD, Sakaguchi, DDS, MS, PhD, "Craig's Restorative Dental Materials", Twelfth edition, Mosby 2006.

222. The gypsum stone type with the highest compressive strength is _____?

a. Type I
b. Type II
c. Type III
d. Type IV

Answer: D Type IV.

Property requirement for Gypsum materials

Type	Setting time (min)	Expansion range%	Comprehensive strength (MPa)	Reproduction of detail
I impression plaster	2.5-5.0	0-0.15	4.0	75 +/- 8
II model plaster	+/- 20%	0-0.30	9.0	75 +/-8
III Dental stone	+/-20%	0-0.20	20.0	50 +/-8
IV High strength/low expansion dental stone	+/-20%	0-0.15	35.0	50 +/-8
V high-strength/ high expansion dental stone	+/-20%	0.16-0.30	35.0	50 +/-8

Powers J.M and Sakaguchi R.L. Craig's Restorative Dental Materials 12th edition

223. Which statement is true concerning the shape of incisal embrasures?

A. As IP contacts are located farther gingivally, incisal embrasures are smaller
B. Incisal embrasures become progressively larger from central to canine.
C. With age and increased wear, the incisal embrasures become larger
D. Incisal embrasures are similarly shaped throughout the anterior teeth

ANSWER: B. Incisal embrasures become progressively larger from central to canine.

The incisal edges of the maxillary central incisors and the cusp tips of the canines should be on the same gently curved horizontal line, with the lateral incisors approximately 1 mm above the line. Beginning with the mesial of the central incisors, the interproximal contacts of the maxillary anterior teeth are situated successively more gingivally, all the way to the distal of the canines. As the contacts become located farther gingivally, the incisal embrasures become larger, creating a more dynamic and youthful smile. With age and increased wear, the incisal embrasures become minimal.

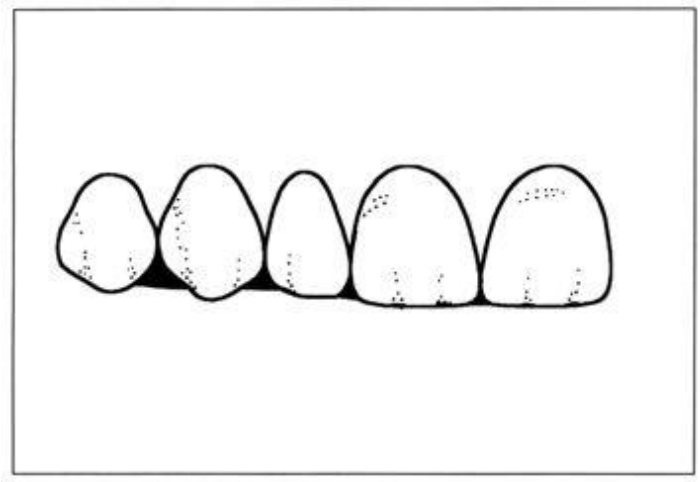


Fig 23-14 Incisal embrasures become progressively larger from central incisor to lateral incisor to canine.

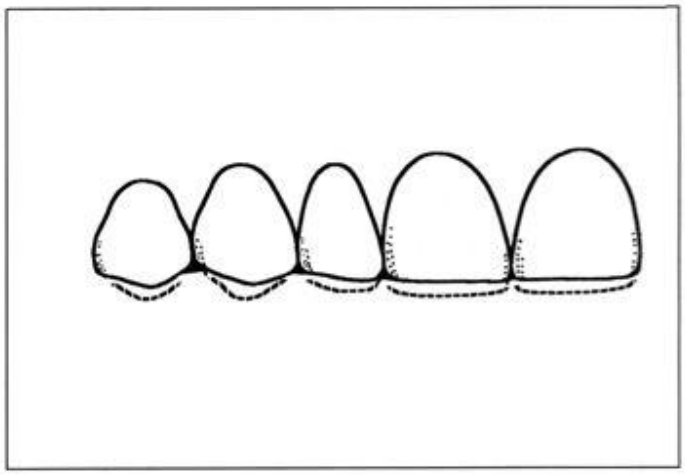


Fig 23-15 Incisal embrasures found in the younger person become smaller, sometimes to the point of disappearing, as the teeth wear.

Shillingburg, H. *Fundamentals of Fixed Prosthodontics, 3rd Edition*. Quintessence Publishing, 1997. 23.1

224. Which of the following is true of the buccal and lingual embrasure forms?

A. Buccal embrasures are usually larger than lingual embrasures
B. Lingual embrasures are usually the same size as buccal embrasures
C. Lingual embrasures are usually larger then buccal embrasures
D. Embrasure form varies and no generalization can easily be made

Answer: C. Lingual embrasures are usually larger then buccal embrasures

Embrasures are V-shaped spaces that originate at the proximal contact areas between adjacent teeth & are named for the direction in which they radiate: 1) facial, 2) lingual, 3) incisal/occlusal, and 4) gingival. Initially the interdental papilla fills the gingival embrasure, thereby preventing trapping of food. In a faciolingual vertical section, the papilla may be triangular between anterior teeth, whereas in posterior teeth the papilla may be shaped like a mountain range, with facial & lingual peaks and the col ("valley") lying beneath the contact area. The col, a faciolingual concave area beneath the contact, is more vulnerable to perio disease from incorrect contact and embrasure form because it's covered by nonkeratinized epithelium.

When an embrasure is decreased in size or is absent, additional stress is created in the teeth and the supporting structures during mastication. Embrasures that are too large provide little protection to the supporting structures as food is forced into the interproximal space by an opposing cusp.

Lingual embrasures are usually larger than the facial embrasures to allow more food to be displaced lingually, because the tongue can return the food to the occlusal surface easier than if the food is displaced facially into the buccal vestibule.

Roberson, Heymann, Swift. Sturdevant's Art & Science of Operative Dentistry, 4th edition. 2002.

Ash. Wheeler's Dental Anatomy, Physiology and Occlusion, 7th edition. 1993.

225. The stress concentration centers in porcelain when under tensile loading ("Griffith flaws") which are:

E. entrapped microscopic air pockets
A. minute cracks and scratches
B. voids incorporated into low-fusing porcelain during firing
C. gaps created when porcelain is treated with HF for more than 2 minutes

Answer: B. minute cracks and scratches

Fracture mechanism of ceramic materials

- Surface conditioning is an important step in strength
- "We do not measure the strength of the glass; we measure the weakness of the surface". *(Preston 1933)*
- There are minute cracks and scratches, submicroscopic in size, on the surface of glass. *(Griffith 1920)*
- These defects, termed "Griffith Flaws", act as stress concentration centers when the glass is subject to tensile loading
- Fracture occurs when the critical breaking stress, concentrated at the flaw tip, is exceeded, resulting in crack propagation *(Stookey, 1965)*

226. Benefits of using a resin cement with an all ceramic crown include all of the following except:

a. No hygroscopic expansion
b. Resin cements have the best physical properties compared to other cement types
c. A more esthetic outcome may be achieved
d. Longevity/retention of the restoration is increased compared to other cement types

ANSWER d. Longevity/retention of restoration is increased compared to other cement types

a. Technique sensitivity. Time consuming and requires strict moisture control
b. Difficult to remove from margins (flash)
For these reasons, many clinicians do not use resin cements routinely for posterior applications.

Some situations dictate the use of resin cements due to their adhesive properties
a. Luting a crown with minimal retention and resistance features
b. Resin cements must be used when bonding all ceramic-noncore crowns.
The resin cements are especially designed for the use with bonded ceramic restorations, but they may be used with cast restorations. **Resin cements have the best physical properties of all the cements. It has been demonstrated that a strong dependable bond between resin and porcelain can be achieved.** The porcelain intaglio surface is etched with hydrofluoric acid to create micromechanical retention sites. Silane is added to the etched surface shortly before bonding and allowed to air dry. Silane coupling agents improve the resin bond to porcelain. **The dentin-resin bond is less dependable than the resin-ceramic bond.**
Summitt et al. Fundamentals of Operative Dentistry. 3rd edition

Pros and cons for the use of resin cements in fixing all-ceramic Crowns
Regarding the points, one can see only one point that might speak for fixing crowns with resin-cements: the esthetics might be negatively affected by conventional cements. Nevertheless, the clinical results in the study of Edelhoff et al. do not support this hypothesis, and it is also questionable whether the higher opacity of conventional cements plays a role at thicknesses of 50–150 μm. **It is a clinical fact that grease-free, clean, and dry surface conditions cannot be fulfilled in most cases. Consequently, the bond can be so bad that polymerization shrinkage of the resin luting media plays a major role in quality of the**

bond. Plaque accumulation is also higher with resins than with other materials in the oral cavity, which could lead to secondary caries or discoloration in the marginal area. **The longevity of dentin bonding is still questionable and needs further investigation. Compared to conventional GICs, the use of hybrid cements has more disadvantages (water uptake and questionable biocompatibility) than advantages.**

Conclusion

The conclusion can be drawn that the stability of all-ceramic crowns might be better when they are bonded to enamel. If enamel is not available, the advantages of resin cements are questionable. From the clinical and practical points of view, there seems to be greater benefit in using glass-ionomer cements, which are "adhesive," release fluoride, and have been clinically well-proven over years. Nevertheless, ceramics have different material traits than alloys. Dentists and technicians have to adopt a "ceramic thinking" to recognize the specific requirements of ceramics. Then, successful clinical work with all-ceramic systems is possible, even if crowns are "only" conventionally cemented.

Pospiech P. All-ceramic crowns: bonding or cementing? Clin Oral Investig. 2002 Dec;6(4):189-97.

Rating Resin Cements

Product	Company	Bonding Agent in Kit	Indications	Curing Mode	Viscosity	Working Time, min	Setting Time, min	Shades	Flexural Strength	Flexural Modulus	Cost, $/n
BISTITE II DC	TOKUYAMA/ J. MORITA USA	PRIMER 1A, 1B, 2	C,IC,M	DC,SC	Low	4.0	3.0	3	M-H	High	52.02
C&B CEMENT	BISCO	None	B,C,IC,M,P	SC	Low	3-4.0	5-6.0	2	M-H	M-H	5.88
CALIBRA	DENTSPLY/ CAULK	PRIME & BOND NT/ SELF-CURE ACTIVATOR	B,C,IC,M,P,V	DC,LC,SC	Med, high	2.5	6.0	5	High	M-H	46.08
CEMENT-IT UNIVERSAL C&B	PENTRON CLINICAL TECHNOLOGIES	BOND-1 C&B	C,IC,M	DC,SC	Low	3.0	4.0	3	M-H	Med	17.36
CHOICE	BISCO	None	B,C,M,V	DC,LC,SC	Med	5.5	7.0	10	M-H	High	11.98
DUAL CEMENT	IVOCLAR VIVADENT	None	C,IC	DC	Med	4.5	8.0	1	M-H	Med	38.90
DUO-LINK	BISCO	None	C,IC,P	DC	Med	3.5	7.0	2	M-H	High	9.99
ILLUSION	BISCO	ONE-STEP	B,C,IC,M,P,V	DC,LC,SC	Med	—	—	>3	High	M-H	30.51
INTEGRACEM	PREMIER	INTEGRABOND	C,IC,M,P,A	DC,SC	Low	3.0	3.5	1	Med	L-M	37.81
LINKMAX	GC AMERICA	LINKMAX SELF-ETCH PRIMER	C,IC,M	DC,SC	Low	3.5	6.5	2	High	M-H	47.22
LUTE-IT!	PENTRON CLINICAL TECHNOLOGIES	BOND-1	C,IC	DC,LC	Low	1.5	4.0	9	M-H	M-H	5.66
M-BOND	TOKUYAMA/ J. MORITA USA	PRIMER A, B	C,IC,M	SC	Low	1.7	4.0	2	L-M	L-M	20.81
NEXUS 2	KERR	OPTIBOND SOLO PLUS	B,C,IC,M,P,V	DC,LC	Low, high	3.5	5.5	5	High	M-H	29.71
PANAVIA F LIGHT	KURARAY AMERICA	ED PRIMER	C,IC,M	DC,SC	Low	3.0	3.0	1	M-H	High	41.30
RELYX ARC	3M ESPE	ADPER SINGLE BOND	B,C,IC,M,P,A	DC,LC,SC	Low	2.0	10.0	2	M-H	M-H	26.47
RELYX UNICEM	3M ESPE	Self-adhesive	B,C,IC,M,P	DC,LC,SC	Med	2.0	5.0	5	Med	M-H	45.00
RELYX VENEER	3M ESPE	ADPER SINGLE BOND	V	LC	Low	—	—	6	M-H	Med	6.76
RESILUTE	PULPDENT	None	C,IC,M,P,A	Hand	Low	6.0	6.0	2	M-H	M-H	8.95
RESINOMER	BISCO	None	M,P,A	DC,SC	Low	4.0	7.0	1	High	M-H	12.37
ULTRA-BOND QUIK	DEN-MAT	None	V	DC,SC	Med	—	10-15.0	3	Med	L-M	10.97
VARIOLINK II	IVOCLAR VIVADENT	EXCITE	C,IC	DC,LC,SC	Low, high	3.5	7.0	12	M-H	M-H	33.59
VISION 2	MIRAGE	ADHESIVE A, B	C,IC	DC,LC	Low, high	1-2.0	3-7.0	6	Med	High	19.53

A=amalgam; B=bridge; C=all-ceramic crown, inlay/onlay; IC=indirect composite; M=metal/PFM; P=post; V=veneer
DC=dual-cured; LC=light-cured; SC=self-cured; ce=currently evaluating; na=not available
*Costs are listed for comparison only and are not used to calculate the ratings.